DOCUMENT RESUME

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ABSTRACT

This is a series of four units introducing the concepts of solids, faces of solids, points, lines, and planes. Emphasis is placed on the discovery approach with a maximum of manipulation and experimentation on the part of the children. Each unit has suggested activities that include games, individual projects, worksheets, and discussion questions. Some objectives and sample evaluative questions are included. (LS)

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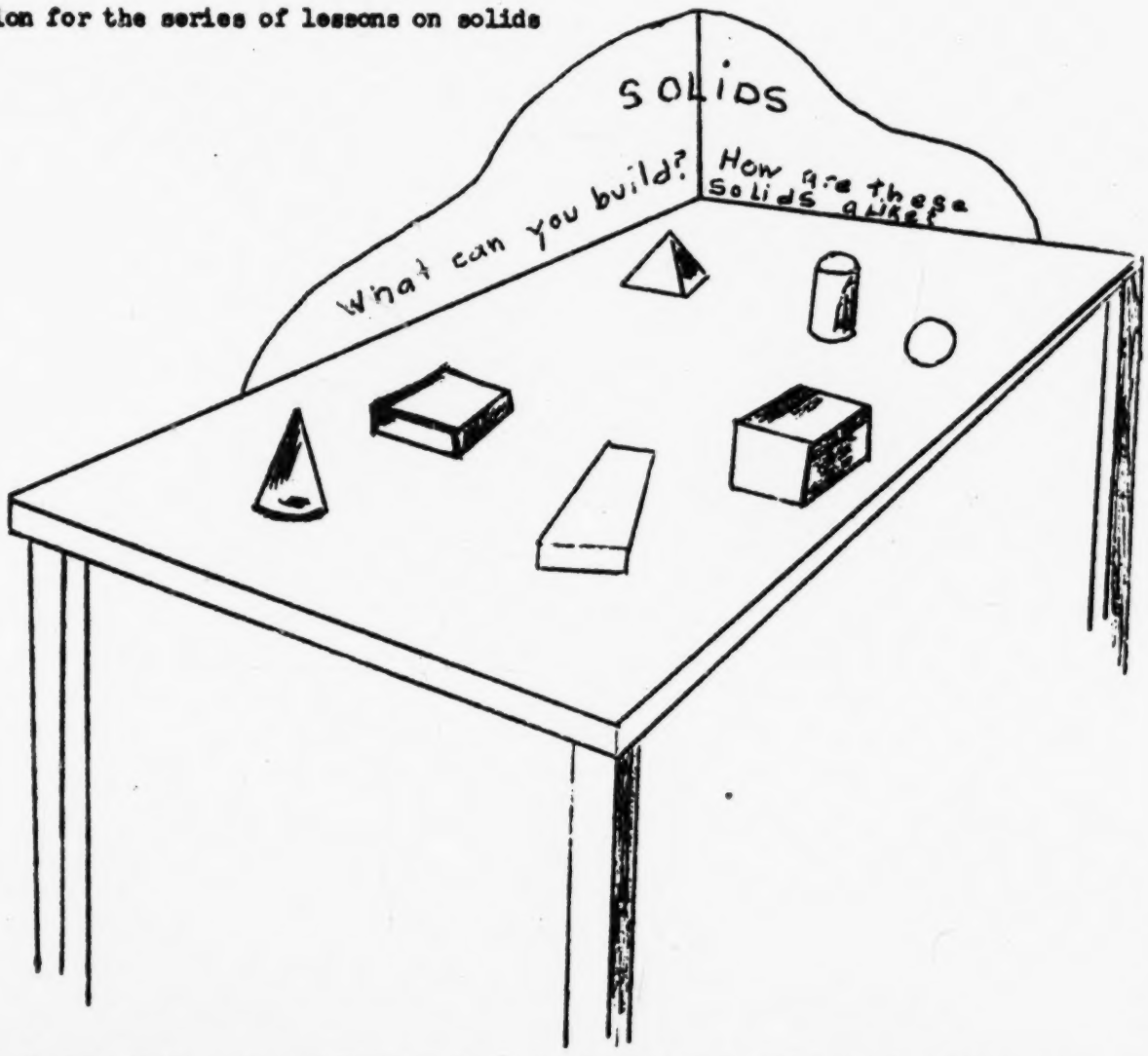
INTRODUCTION OF SOLIDS

GRADE ONE	GRADE TWO	GRADE THREE
sphere	sphere	sphere
cube	cube	cube
rectangular prism	rectangular prism	rectangular prism
cylinder	cylinder	cylinder
cone	cone	cone
	square pyramid	square pyramid
	triangular prism	triangular prism
		others

SE015 356

SOLIDS

Preparation for the series of lessons on solids



A few days before this series of lessons is to begin set up a table display of solids in the classroom.

Add a few more solids each day.

Encourage pupils in their spare moments to handle and experiment with the solids. They will build models, sort, categorise and discuss.

Note the comments made by the pupils as they experiment. They may provide excellent motivations for the lessons which follow.

(Very little participation on the part of the teacher is necessary at this stage).

SOLIDS

UNIT ONE — General Discoveries Concerning Solids

Aims:

1. to guide the pupils, through handling and manipulation, to make discoveries concerning solids.

2. to have the pupils become familiar with, and eventually learn the names of the geometric shapes.

3. to develop in the pupils an ever-increasing awareness of (a) the geometric shapes in their environment and (b) the purposes these shapes serve.

Solids have completely closed surfaces

- are rigid
- are three dimensional
- can be handled
- some have flat faces
- some have curved surfaces
- some have faces of more than one shape
- some have vertices
- some have edges
- some slide
- some roll.

Then children may work individually or in groups.

Approach:

Provide each child with a set of geometric solids and ask him to examine each one in order to discover as much as he possibly can about solids in general.

Allow sufficient time for the children to experiment on their own, providing help only where the need is apparent.

Following experimentation encourage the children to share their discoveries. Their comments may be similar to the following:

1. "All my solids are hard. When I squeeze them they do not change shape."

2. "Some of my solids have edges."

3. "Some of my solids have sharp points, because I can feel them with my fingers."

4. "One of my solids looks like an up-side-down ice-cream cone."

5. "Some of my solids have flat surfaces and some have curved surfaces."

6. "Some of my solids roll easily on the desk, others slide."

As each child reports he should use his set of solids to demonstrate his discovery.

If a tape recorder is used it should be in a prominent place in the room and discoveries which are especially interesting may be recorded and played several times during the series of lessons. This device will serve to maintain a high rate of interest as children are fascinated by the sound of their own voices.

Geometry and reading may be correlated by typing and tape-recorded discoveries on stencils and making individual booklets for the children. Grade one pupils, in particular, will enjoy reading the stories they have composed and recorded.

Have the children look around the classroom for objects that are shaped like the solids. (Make sure there is a good assortment of boxes, balls, cans, etc.) When a child discovers a similar shape, he should tell the purpose it serves and indicate the solid it resembles. A typical comment might be "This box looks like that solid (cube). It holds coloured chalk."

(If the children ask what the solids are called have them suggest names giving their reasons for doing so. Tell the proper names but in the early lessons do not expect the children to use them freely.)

Have the children name something in their homes, in the parks and playgrounds, and on the streets that is similar in shape to one or more of the solids. "What purpose does it serve?"

<u>Related Activities</u>

1. (a) Children make models of solids from plasticine or asbestos — make a table display.

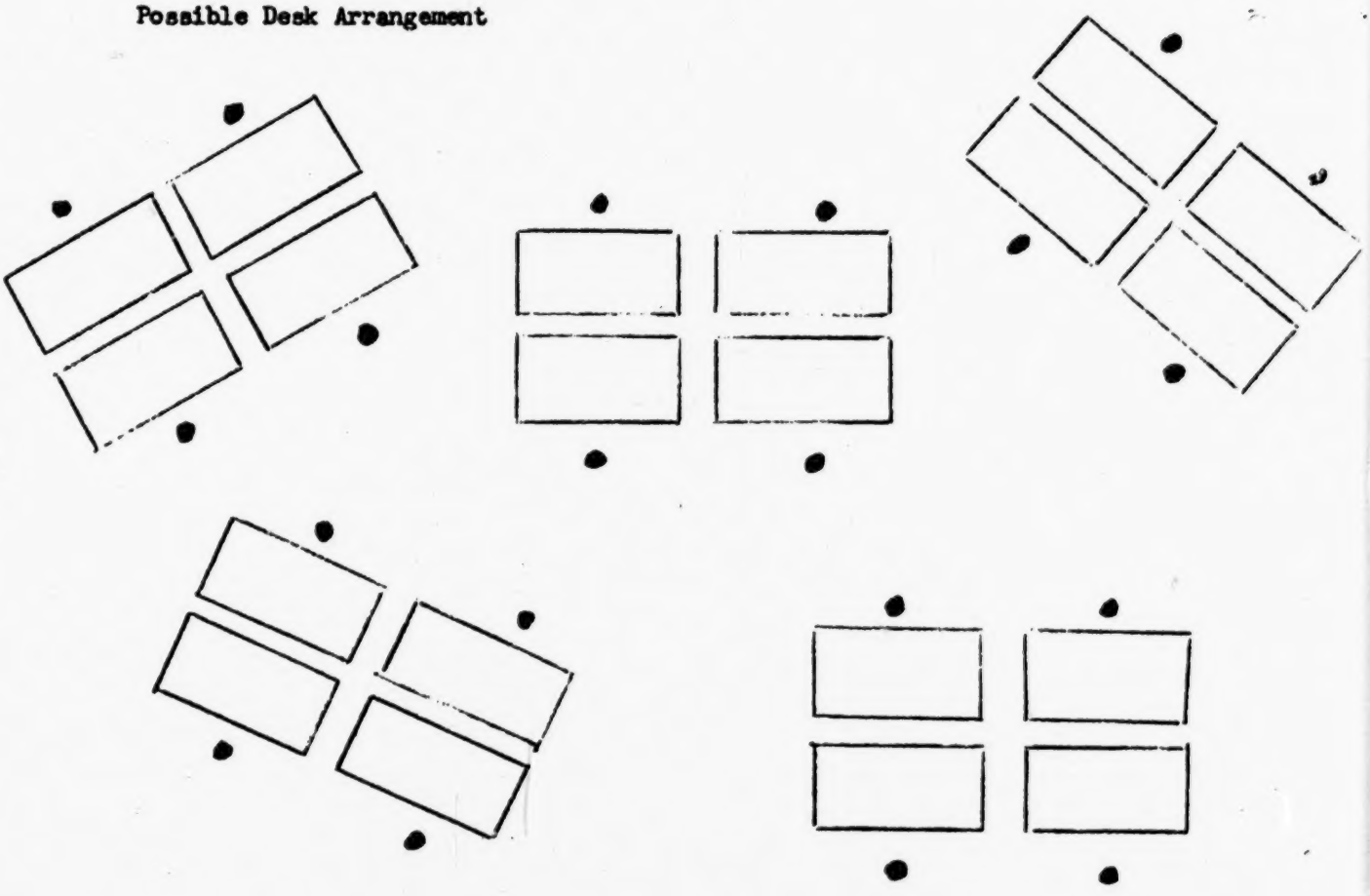
   (b) Children bring to the classroom a collection of geometrically-shaped objects -- discuss their similarities to the solids — classify them -- discuss their purpose. (They may add to the collection daily.)

UNIT 2 — Discovery of the Similarities and Differences in Geometric Solids

AIM

To have the children compare the members of the set of geometric solids and find as many subsets as possible.

Possible Desk Arrangement



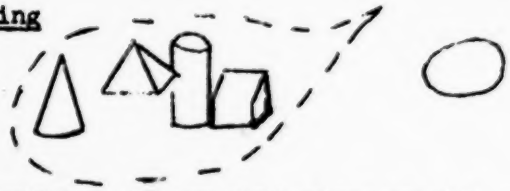
Approach

Provide each child with a set of solids and ask him to group the solids that have something in common. (Demonstrate if necessary.)
Allow plenty of time.
Ask the children to give reasons for the groupings they have made.
Here are a few of the possibilities.

Grouping

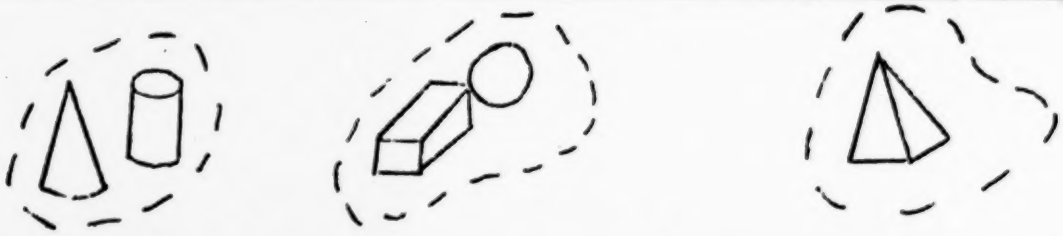
Explanation: "I have separated the solids into 2 groups and I put 3 shapes into this group because all these shapes roll".

Grouping



Explanation: "I can fell edges on all the shapes in this group".

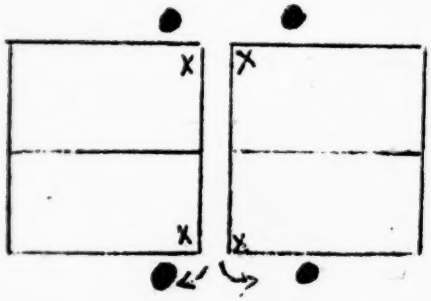
Grouping

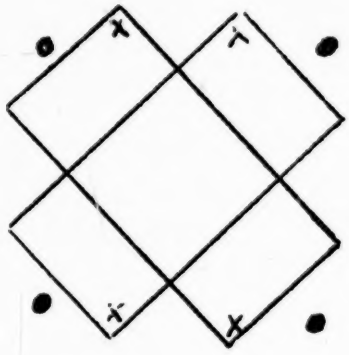


Explanation: "My solids are in three groups. One group has flat faces that look like circles. The second group has two shapes that are the same as shapes in the toy box at home, and the third group is different from the other two groups."

After several children have explained their methods of grouping to the class, each child may explain his grouping to his three immediate neighbours.

By moving only the corner of each desk (see below), an effective seating arrangement is made. Each "chairman" in turn can be seen by the others in his group. In a comparatively short time, all "chairmen" will have explained their reasoning to their peers -- a creative language experience involving full class participation.





Related Activities:

Several types of work sheets may be provided to consolidate or review the discoveries.

Examples:

1. Grade one -- a sheet of pictures of geometric shapes -- children cut, arrange and paste the pictures into specified subsets.
2. Grades two and three -- a sheet of headings -- children print or write the names of the solids that come under each heading.

The solids with curved sides

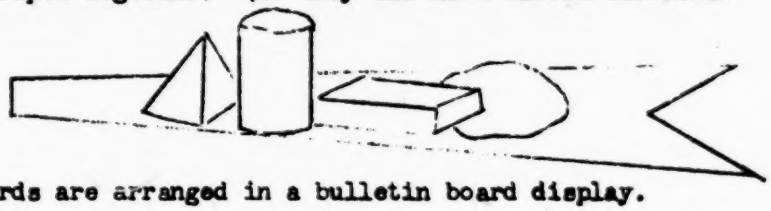
The solids with circular faces

The solids that roll

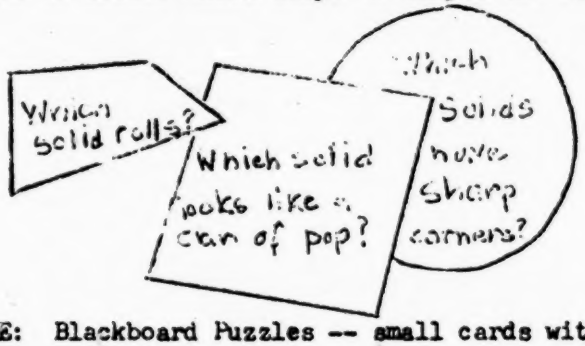
etc.

3. 'Riddle Areas' used as group assignments or as 'Extra Work' corners may be introduced.

RIDDLE AREA ONE: A shelf or table flat cardboard shapes is set up. On each piece of cardboard, several solids are placed. Children are invited to suggest why certain shapes have been grouped together. (Do they all have curved surfaces? Do they all have edges ? etc.)



RIDDLE AREA TWO: Assignment cards are arranged in a bulletin board display. Children are asked to decide which shape or shapes the assignment cards describe.



RIDDLE AREA THREE: Blackboard Puzzles -- small cards with miniature solids mounted on them are arranged on the blackboard with plastitak. Children are invited to group the shapes and write the reasons for their groupings.

I put these solids together because they have sharp edges
Janie

RIDDLE AREA FOUR: Children enjoy riddles on experience chart paper. They may write answers on paper or merely indicate what they believe to be the right choice by placing a solid underneath the chart and discussing the reasons for their choices with friends.

4.
I have a sharp point. One of my faces is shaped like a circle. WHICH SOLID AM I?

UNIT THREE — Characteristics of Individual Solids

Aim — To have the children discover the characteristics of each solid.

Cube: -

six faces, eight vertices, twelve edges, all faces are square-shaped and of the same size, all edges are equal in length, slides on all faces.

Rectangular prism: -

six faces, eight vertices, twelve edges, opposite faces are the same shape and size, opposite edges are equal in length, slides on all faces.

Sphere: -

surface is completely curved, no vertices, no edges, rolls in a straight path.

Cone: -

one circular face, curved surface, one vertex, one circular edge, rolls in a circular path, slides on one face.

Cylinder: -

two circular faces, curved surface, two circular edges, no vertices, opposite faces are of the same size, rolls in a straight path, slides on faces.

Square-based pyramid: -

one square face, four triangular faces, five vertices, eight edges, base edges are equal in length, face edges are equal in length, slides on all faces, stands on all faces.

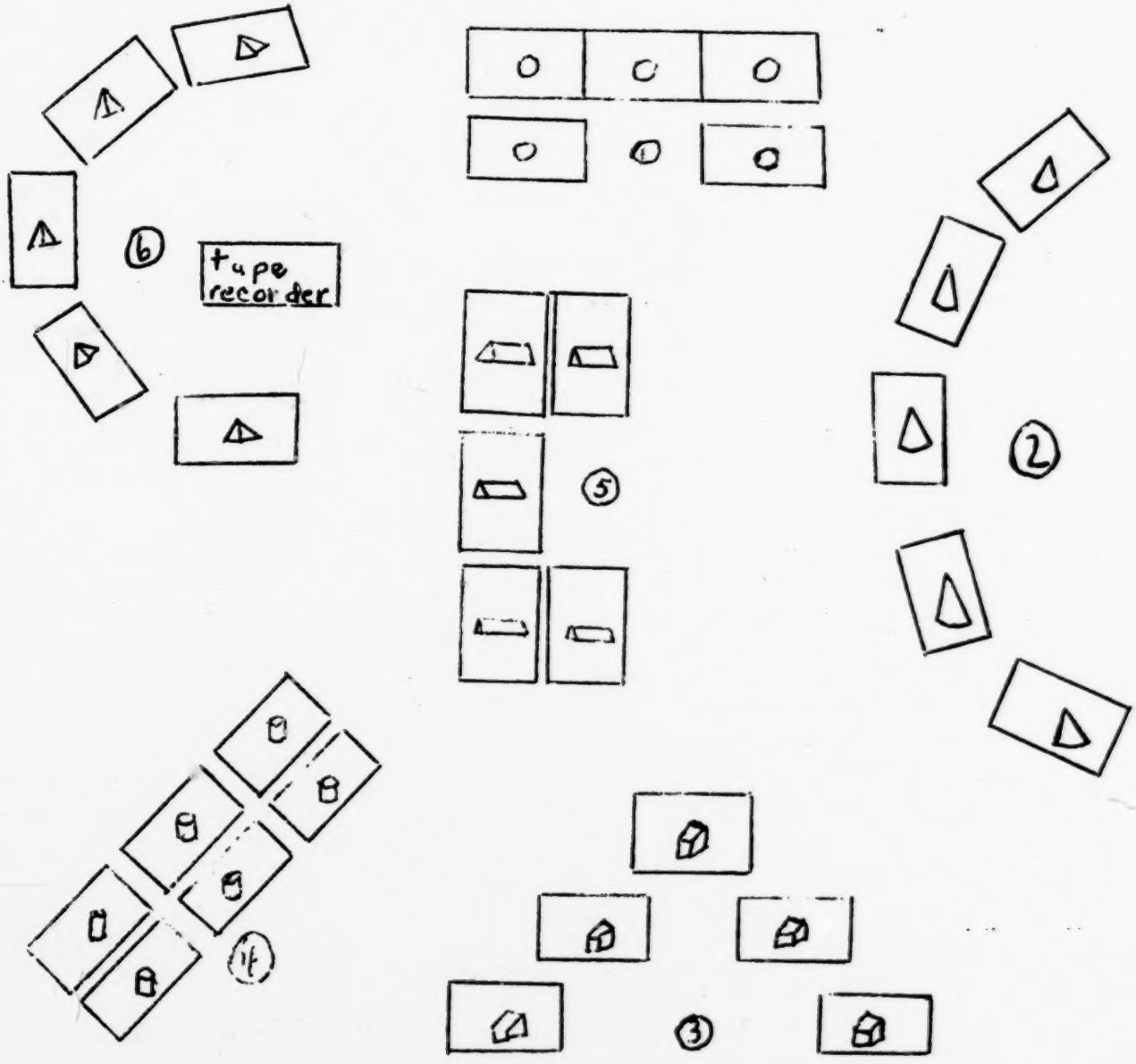
Triangular prism: -

five faces, six vertices, nine edges, three faces are rectangular and of the same size, two faces are triangular and of the same size, slides on all faces.

Approach 1:

Suggested Desk Arrangement: -

A station is set up for each solid to be examined. (In early grade one it may be preferable to have the whole class examine one solid at a time).



Ask the pupils to examine the solids on their desks to see what they can discover about each one. Explain carefully how each group is to record its findings, then let the groups work individually, offering help only where it is needed.

Suggestions for Recording Discoveries:

The following suggestions may be used as a guide to the different methods of reporting.

Group one -- sphere -- may record discoveries on paper in list form (Slim Jim).

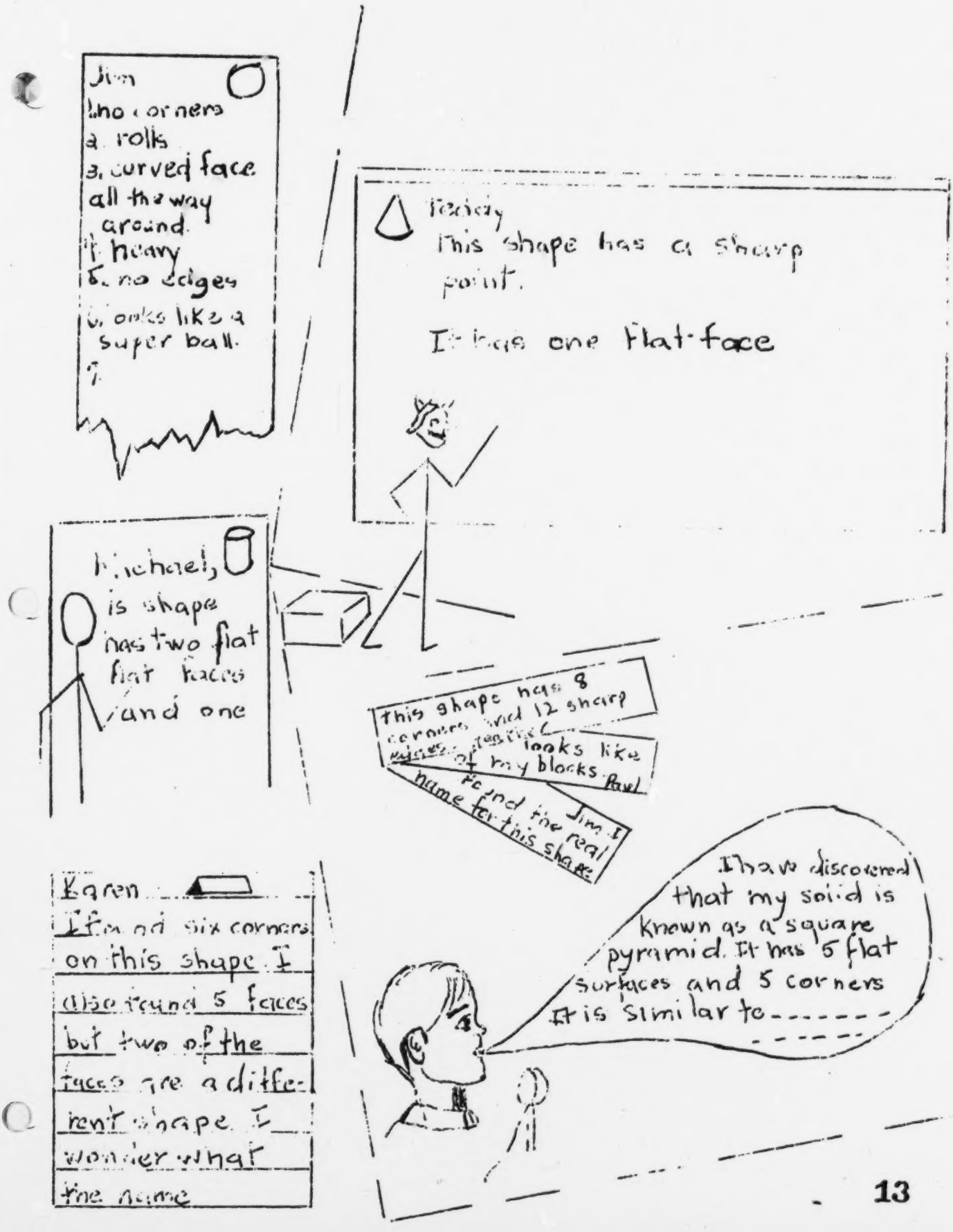
Group two -- cone -- may record discoveries on the blackboard.

Group three -- cube -- may record discoveries with crayons on large cards to be used in a bulletin board display.

Group four -- cylinder -- may record discoveries with markers on experience chart paper.

Group five -- triangular prism -- may record discoveries directly on stencils which will later be made into booklets.

Group six -- pyramid -- may record discoveries orally on tape recorder.


Jim
1. no corners
2. rolls
3. curved face all the way around
4. heavy
5. no edges
6. looks like a super ball.
7.
Tracy
This shape has a sharp point.
It has one flat face
Michael,
is shape has two flat flat faces and one
this shape has 8 corners and 12 sharp looks like my blocks. Paul
found the real Jim. I name for this shape
Karen
I found six corners on this shape. I also found 5 faces but two of the faces are a different shape. I wonder what the name
I have discovered that my solid is known as a square pyramid. It has 5 flat surfaces and 5 corners It is similar to

It may take three or four days to rotate each group through every station. When this has been done, the pupils should be given many opportunities to examine outstanding results of their work. This may be a lesson with the whole class, or, if interest is still high, the rotation methods may be continued.

Example: - Choose five exceptionally good discovery lists -- place one on each of the desks in group one — pupils take turns reading the lists aloud.

All the activities mentioned in the development of this lesson should be 'open-ended'. Children may add to the results at any time.

Example: - They may prepare Slim Jim lists for other solids to match those of the sphere -- add to the experience charts at any time -- etc.

Approach 2

Hide one of the solids in a paper bag. Tell the children they may determine which solid is in the bag by asking questions and listening carefully to the answers. Their questions should be listed on the blackboard as they are asked. When they have determined which solid is in the bag have the children, working in groups, examine a model of it and record all their findings for reporting, using the questions on the blackboard as guides.

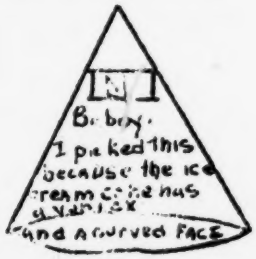
Recording and reporting to the class may be done as described above.

Repeat with each solid.

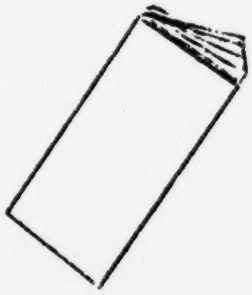
Related Activities

1. Teacher prepares large models (three to four feet high) of solids — pupils find pictures from the picture file of objects that are shaped like the teacher's models — cut out picture and paste them on the solids they resemble, each picture being accompanied by an oral explanation.

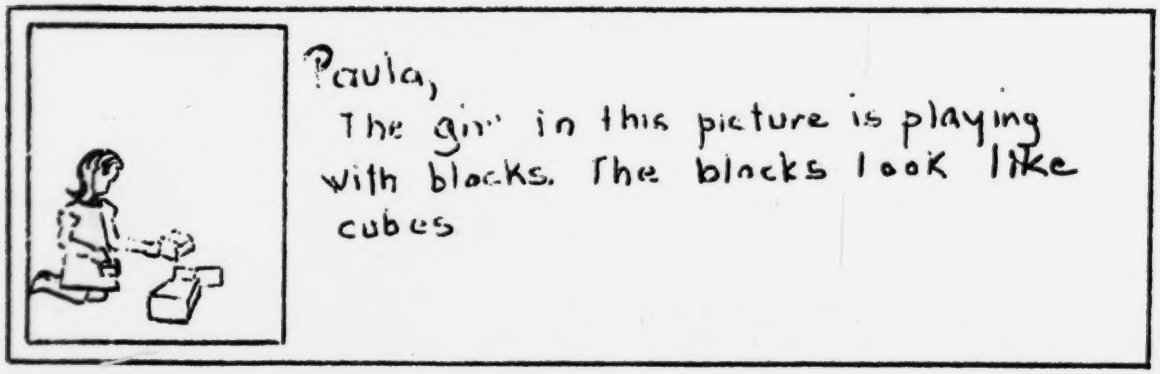
2. From the picture file each child may choose a picture containing an article resembling a solid -- teacher provides mountings cut in the silhouettes of the solids. Each child chooses the mounting suggested by his picture -- pastes the picture on the mounting -- writes on the mounting the reason for choosing it -- pastes or hangs the mounting on the model (See 1 above)



3. Children may make individual booklets -- with or without written explanations.



4. Children may paste a chosen picture on experience chart paper and prepare a written story in crayon or magic marker beside or below the picture.



5. Each child may paste a magazine picture of a soild shape on coloured paper and prepare written sentences to accompany the picture (riddle form if desired).

6. Answer cards may be matched to riddle cards.

7. Game — Who is in the Bag? — a geometric solid is placed in a paper bag — a blindfolded child places his hand in the bag and identifies the solid by feeling it.

8. Puppets: — geometric-shaped puppets hold conversations with other shapes, with people from Mars, etc. — individual characteristics are discussed in the conversations.

UNIT FOUR -- **Review and Summarization of the Characteristics of Individual Geometric Solids**

Aims:

1. to provide a review of the characteristics of the individual geometric solids.

2. to assist the children in planning a concise method of organizing and summarizing all their findings concerning solids.

3. to lead them to discover that for solids without curved surfaces F + V - E = 2 where F = the number of faces, V = the number of vertices and E = the number of edges.

Some method should be devised for marking the faces, edges and vertices so that they may readily be counted, e.g., dabs of coloured plasticine, coloured stickers, small crayon marks.

Approach:

Pretend to be scientists ready to review and report all the information that has been discovered concerning each of the solids.

Invite the children to suggest the procedure that might be followed. By questioning, lead them to realize that the first step is to recall all the discoveries they have made.

If the class is working as a group, have a child choose the first solid to be reviewed. Write the proper name on the blackboard and as the children recall the characteristics list them under the name. If vital information is not forthcoming, assist by questioning.

Treat each shape similarly.

Have the children read and check all the information on the blackboard.

At this point suggest that they try to plan a neater, clearer method of recording all this information. If they have had no previous experience in recording in chart form, this is a good opportunity to introduce it.

Sample chart

SOLID	NUMBER OF FLAT FACES	NUMBER OF VERTICES	NUMBER OF EDGES	CURVED SURFACES	OTHER INTERESTING FACTS
Cube					
Cone					
			etc.		

Later have them draw up a chart which shows only the number of faces, vertices and edges.

SOLID	NUMBER OF FACES	NUMBER OF VERTICES	NUMBER OF EDGES
Cube	6	8	12
Pyramid	5	5	8
Triangular prism	5	6	9

Ask them to look for the number pattern in the chart. This should present no difficulty for children in late grade two and in grade three.

Introduce the formula F+ V-E 2 as a simple method of describing the pattern, discuss it and give the children plenty of practice in applying it.

Related Activities

1. A dozen or so riddles may be recorded on tape, i.e.,

   "I am a tall solid with one flat face.
   My head is pointed.
   When you hold me up-side-down, I look like something good to eat.
   Which solid am I?"

   The children listen to the recording and write the answers on paper: -

Answers to Riddles
1. c o n e
2.
3. etc.

   Later they may be asked to make up riddles to be recorded.

2. Working as a class or in individual groups the children may
   (a) make graphs of specific aspects of the information discovered.

   Example

   Graph showing the number of faced of each solid

	1	2	3	4	5	6	7	8	9	10	11	12
Cube												
Rectangular Prism												
Pyramid												

   (b) compare two or more solids and enter their discoveries on stencilled sheets.

SOLID_____	SOLID_____
Number of vertices	
Number of edges	
Number of flat faces	
Flat surfaces shaped like triangles	
Flat surfaces shaped like circles	
Flat surfaces shaped like squares	

etc.

(c) make puppets using solids for the heads -- puppets argue among themselves as to which, because of his shape and individual characteristics, is best suited for certain given purposes.

3. Some children may enjoy composing verses about the solids. Children may sing (to Clementine) the following verse about the cube -

"Edges twelve, edges twelve,
Edges twelve, Oh, count them please
You will find my six flat faces
Meeting at eight vertices."

They hold cubes in their hands and point to faces, etc., as they sing. Then, holding in succession the pyramid, rectangular prism, triangular prism, they repeat the verse substituting the right numbers for the faces, edges and vertices.

"Can we sing this song about the cone?" "the cylinder?" "the sphere?" "Why not?"

Some children may enjoy making up similar verses to other familiar tunes.

UNIT FIVE -- Evaluation

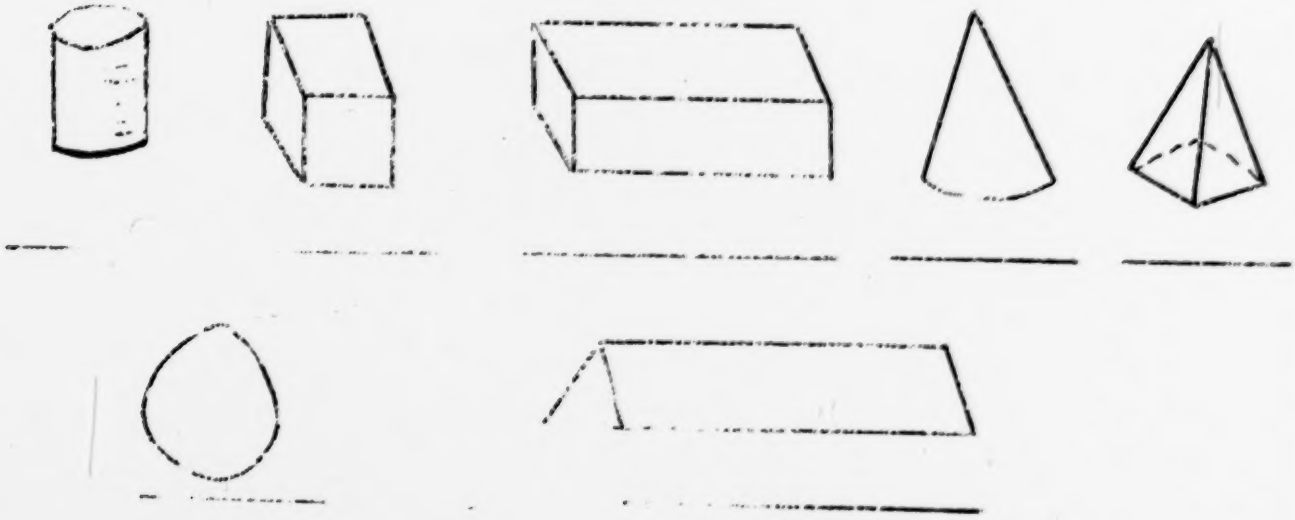
Solids have been taught thus far with a maximum of manipulation, experimentation and discovery on the part of the children. As a culmination activity some means of testing must be devised to determine the progress the children have made. The testing programme must not destroy their confidence in their own ability nor dull their enthusiasm for geometry. Its purpose is to assess the children's grasp of concepts concerning three-dimensional geometry.

In grade one evaluation will be individual and oral, the questions asked being similar to those in the tests below. In grades two and three it may be in the form of stencilled work sheets.

Examples:

1. Identification of the shapes:

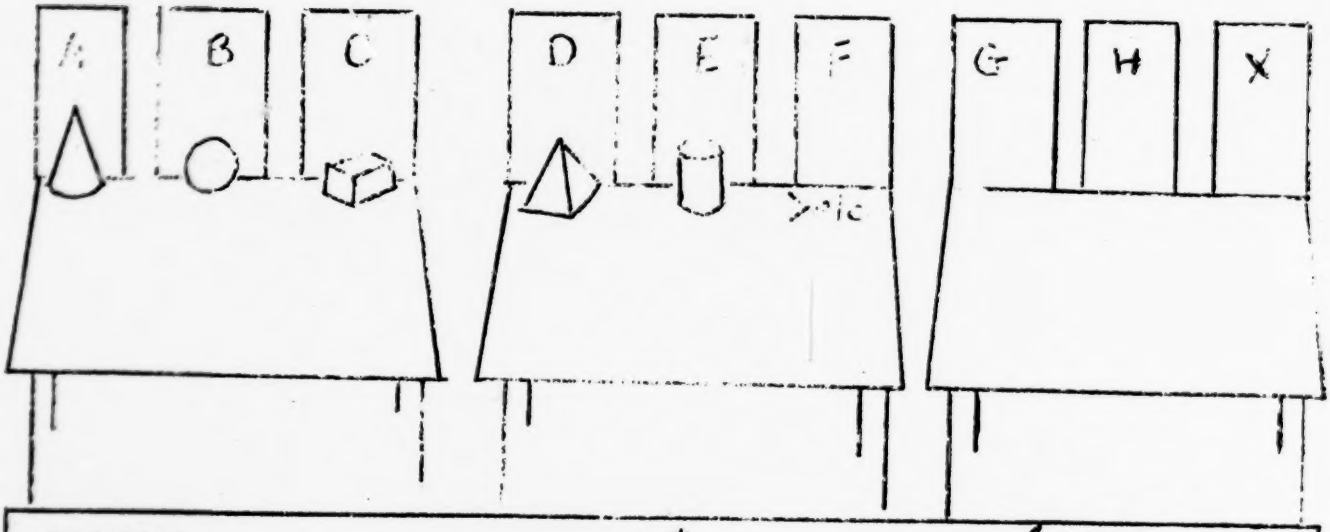
   (a) Write the name of the shape under each picture.



   (b) A number of solids are placed on a table in front of the class -- the children look carefully at the collection then, at a given signal close their eyes -- the teacher removes a solid -- pupils open their eyes, name and describe the missing solid.

2. Shapes in the Environment

Directions: "To-day I am going to see how much you can remember about the solids we have been experimenting with for the past two weeks. On the tables I have set out one of each type of solid. Each solid has a large letter behind it. For instance, the cone has a large letter A, the sphere a large letter B, and so on. I am going to ask you to answer some questions. The questions are about solids. If you think that the answer to one of the questions is 'cube', then all you have to do is circle the C on your paper beside the question. If the answer were 'cylinder', what letter would you circle? If there were two answers, 'cone' and 'pyramid', what two letters would you circle? Put your finger on Question One".



name _____ date _____ Section A

Solids

Which solid looks like the red, blue and white balls we use in the gym?

A B C D E

3. Characteristics of Individual Solids.

(a)

NAME	NUMBER OF FACES	NUMBER OF VERTICES	NUMBER OF EDGES
Pyramid			
Rectangular Prism			
	etc.		

(b)

Write all the names of the solids that come under these headings		
one vertex	Twelve edges	a circular face
_____	_____	_____
_____	_____	_____
_____	_____	_____
Shapes that have curved surfaces.		
_____		
etc.		
_____		

(c)

Which shapes have all edges equal in length?
etc.

(c) Directions

The children have their own sets of solids available to fill in the charts. The teacher gives out 2" x 2" cards with letters A to ? -- one for each shape. She tells the children to place certain shapes on certain letters -- cylinder on A, pyramid on B, and so on. "IT IS MOST IMPORTANT THAT EACH SHAPE STAY WITH ITS LETTER ! ! ! "

Before the test begins the questions may be read orally as a class project. When answering the question the children record the letter representing the solid.

Name: _____ Section: _____ Date: _____	Answers
1. Which shapes have more than six edges?	A, C, E.
2. Which solid has only one vertex?	
3. Which shapes have five flat surfaces?	
4. Which solids roll? etc.	

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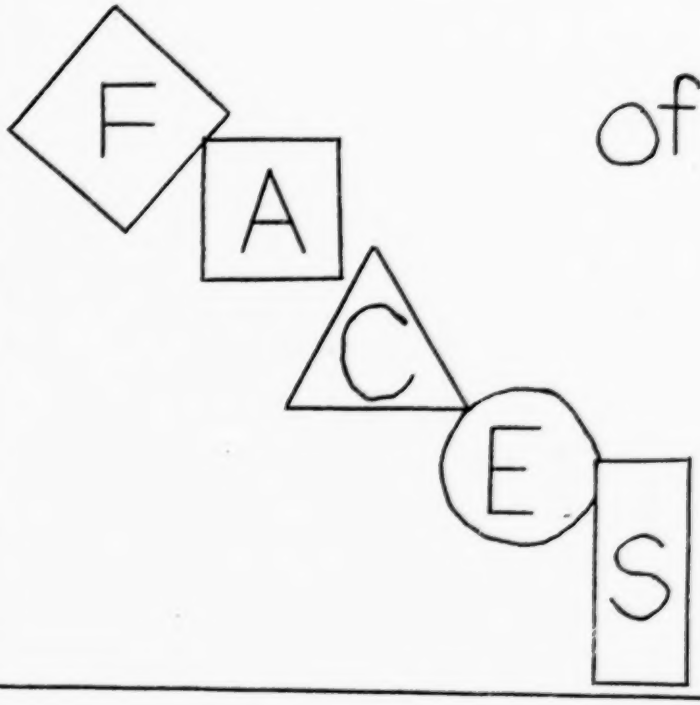
Topic Two

Introduction of FACES



UNITS:

1. General Discussion about the Faces of the Geometric shapes.
2. Discovery of the Characteristics of the Plane Shapes.
3. Review and Summary of the Characteristics of the two-Dimensional shapes.
4. Evaluation.

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TOPIC TWO

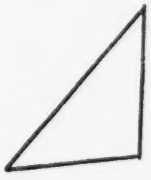
INTRODUCTION OF FACES

AIMS:

1. To have the children relate the shape of the faces of the geometric solids to the plane shapes - circle, triangle, square, rectangle.

2. To develop in the children an understanding that the drawing is the triangle, circle, rectangle, square, but that the cut-out shape of a face is a triangular shape, a square shape, a rectangular shape or a circular shape.

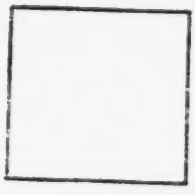
3. To have the children discover the characteristics of the plane shape.



TRIANGLE - three sides

three vertices or corners

some of the sides or corners maybe equal in length or size



SQUARE - four sides

four vertices

four sides equal in length

four equal corners

RECTANGLE - four sides

two opposite sides are equal in length

four equal corners

CIRCLE - no vertices

no straight sides

you may turn it any way and it fits itself

UNIT ONE

General discussion about the faces (flat sides) of the geometric shapes.

AIMS:

1. To have the children examine and discuss their observations of the faces of the geometric shapes.
2. To trace the faces of the geometric shapes.
3. To compare the faces.
4. To name the shapes of the faces.

APPROACH:

Develop, with the class, a reason for looking at the faces and learning about them. (i.e. - tell the children that a visitor from Mars wants the earthlings to teach him all about the faces)

OR

The geometric shapes could come to life and will answer all the boys' and girls' questions about the faces or will ask the boys and girls questions about the faces on the geometric shapes.

OR

Create suspense by conducting a review of the characteristics of solids and, as a child tells about each shape, the teacher mysteriously colours only one of the faces on each shape, red (giving no reason to the children). In order to organize their thinking, the class could list on the blackboard or on chart paper the questions which they are asking themselves about the faces. The teacher may add a few questions of her own if necessary. In Grade One or early Grade Two, the questions could be taped.

APPROACH: (Cont'd)

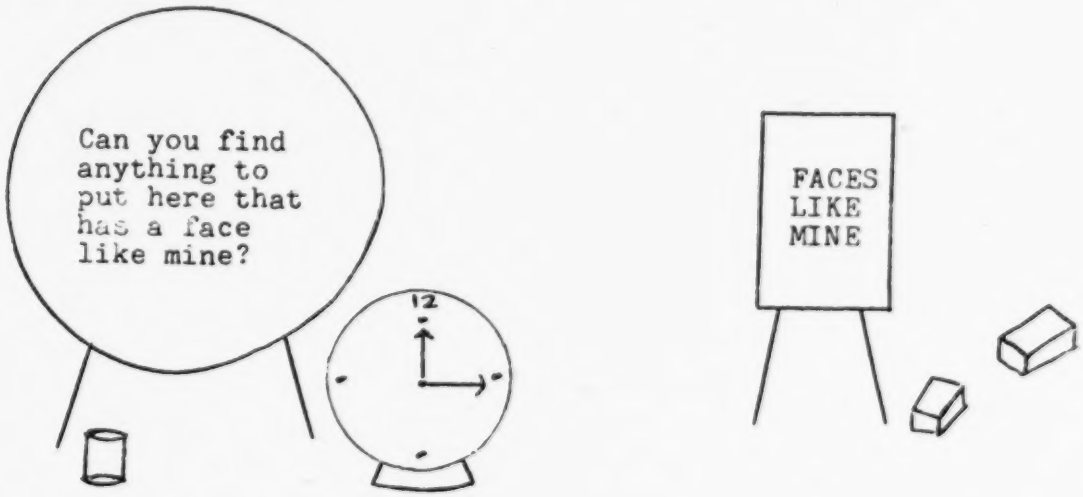
What do we want to find out about the faces?

1. How many sides does it have?
2. What would you call the shape of the face?
3. Are the faces all the same on the solid?
4. Are the edges of the face equal in length?
5. Are the corners the same size?
6. How many corners does it have?
7. Is the same face on more than one geometric shape?

Next, have the class choose one shape at a time to examine in order to discover the answers to their questions. Class discussions of their findings should follow after the children have had time to examine and trace the faces of each shape. (The children will not necessarily do any written reporting at this time).

RELATED ACTIVITIES:

1. Make the shapes of the faces on the geo-boards with coloured elastics.
2. Make collections of objects in the room with faces similar to the faces on the solids.



UNIT ONE (continued)

RELATED ACTIVITIES: (cont'd)

3. Work Sheets

(a) Drawing straight edge faces by joining points in a series of arrays.

1. Use your ruler and a pencil to make a square.

2. Now draw a square that is twice as big as the first one.

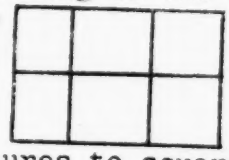
(b) For a sheet of geometric shapes, give directions such as:

1. - Colour the squares red.
   - Colour the circles blue.
   - Colour the triangles yellow.
   - Colour the rectangles brown.

2. - With a line, match the faces that are the same.

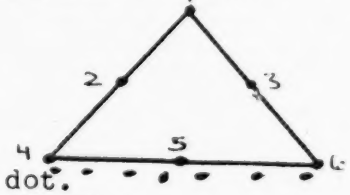
(c) Finding Square Numbers:

Use graph paper.
Build squares by colouring in the small squares, beginning with a corner square.



Now relate these pictures to square numbers.

(d) Finding Triangular Numbers:



- Place a number on each dot.
- Join the dots to form triangles.
- How many dots make the first triangle?
- How many dots make the second triangle? etc.

4. Building class charts or taping points which children discover during the general discussion of different shapes of the faces contained on the solids.

UNIT TWO

Discovery of the Characteristics of the Plane Shapes

AIMS:

1. To have the children discover specific characteristics of the plane shapes (see characteristics listed in the aims).
2. To have the children trace and cut out the faces of the geometric shapes.
3. To have the children use the cut-out models of the faces to prove some of their observations (i.e. the corners are the same size OR the sides are equal).
4. To have the children record and share their findings about the characteristics of the plane shapes.

APPROACH: GRADE ONE AND EARLY GRADE TWO

Ask the children to trace on construction paper all the square faces from their solids. Questions may be asked orally or work sheets or assignment cards given out. Questions could be similar to the following:

Square Shapes

1. How many sides are there?
2. What do you notice about the edges of the square shape?
3. How many vertices or corners are there?
4. How can you describe the corners of the square?
5. Which geometric solids have square faces?

Some of the statements will require verification. For instance, if someone suggests that all the edges are the same length, ask him how he can verify the statement. Some child may suggest cutting the face out and comparing the edges by folding, or cutting out two faces and comparing them, or measuring the sides with a ruler or string. Have plenty of material ready for use in verification.

It is very important that the children be given opportunities to think through their own methods of verification rather than have a method suggested by the teacher.

APPROACH: (Cont'd)

Circular Shapes

1. How many straight edges are there?
2. How many corners are there?
3. Take two circular shapes the same size and see how many different ways one circle will fit on the other.
4. What geometric solids have circular faces?

Triangular Shapes

1. How many vertices are there?
2. How many sides are there?
3. What can you tell about the length of the sides? Verify.

Rectangular Shapes

1. How many vertices are there?
2. How many sides are there?
3. What else can you tell about the sides? Verify.
4. What can you verify about the corners?

All Shapes

1. Fit one of each of the shapes together.
2. What can you tell about the way the shapes fit together?

There are many materials available for tracing and cutting the shapes of faces and it is suggested that the children use a different method for each of the plane shapes. Here are a few suggestions:

1. wall paper
2. plastic
3. bristol board
4. balsa woos
5. pencil
6. crayon
7. wool
8. chalk
9. magic marker
10. leatherette
11. straws and pipe-cleaners
12. geo-boards
13. plaster of Paris
14. plasticine
15. velour paper
16. gummed paper
17. material (felt, etc.)
18. long pipe-cleaners

APPROACH: GRADES TWO AND THREE

Assemble the children with their necessary materials in groups.

Read the assignment cards through and clear any difficulties. This may take one whole period.

When the assignment cards or work sheets are completed, the group should decide upon their method of recording information, gather the necessary materials and begin to work.

When the records are complete, then the reports should be shared with the other class members. This will also give the teacher an opportunity to evaluate and add to the anecdotal records of each child.

ASSIGNMENT CARD

SAMPLES

TRACE AND CUT OUT ALL THE SQUARE SHAPES.

1. How many sides are there?
2. How many vertices or cornersare there?
3. What can you tell about the sides? How can you prove this?
4. What can you tell about the corners? How can you prove this?
5. What geometric solids have square faces?

Pick a leader in your group and discuss the answers to the questions.

Now choose a method of recording your answers and begin.

TRACE AND CUT OUT ALL THE RECTANGULAR SHAPES.

1. How many vertices are there?
2. How many sides are there?
3. What else can you tell about the sides? How can you prove this?
4. What can you prove about the corners?

Pick a leader in your group and discuss the answers to the questions.

Now choose a method of recording your answers and begin.

APPROACH: GRADES TWO AND THREE

Assignment Card

Samples

Trace and cut out all the triangular shapes.

1. How many vertices are there?
2. How many sides are there?
3. What can you tell about the length of the sides? How can you prove this?

Pick a leader in your group and discuss the answers to the questions.

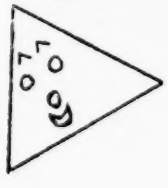
Now choose a method of recording your answers and begin.

Trace and cut out all the circular shapes.

1. How many straight edges are there?
2. How many corners are there?
3. Take two circular shapes the same size and see how many different ways one circle will fit on the other. (This may require demonstration)
4. What geometric solids have circular faces?

Pick a leader in your group and discuss the answers to the questions.

Now choose a method of recording your answers and begin.



Choose the way you wish to record your information. Only one group may tape and only one group may work on the bulletin board.
Do you know why?

Recordihg:

1. Booklets: Write all the answers to the questions on lined paper in a story form. Make pictures to go with them. Make a cover and put the stories and pictures into a booklet. Organize your own group quietly.

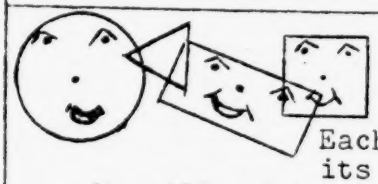
2. Tape Recording: Make a tape recording of the questions and answers. It may be best to choose one person as an announcer and question reader, and the rest of the group take turns answering the questions.

APPROACH: GRADES TWO AND THREE (Cont'd)

Recording:

3. Charts: Choose one piece of chart paper for each face and some magic markers. Divide your group so that each face has one or two working on it. Write all you know about each face. Before the charts are finished, check with the rest of the group to see if anything is left out.

4. Bulletin Board: Write on white cards all the things you have learned about the faces. Arrange them with coloured yarn or drawings of the faces on the bulletin board.



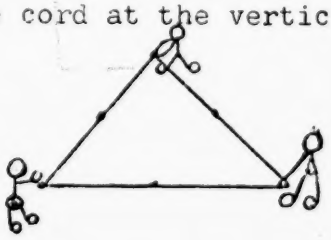
Sharing with the Class

Be ready to report about us to the rest of the class on _____.

Each group will show the method of recording and read its record or play the tape to the rest of the class. We will need time for discussion after each report.

RELATED ACTIVITIES:

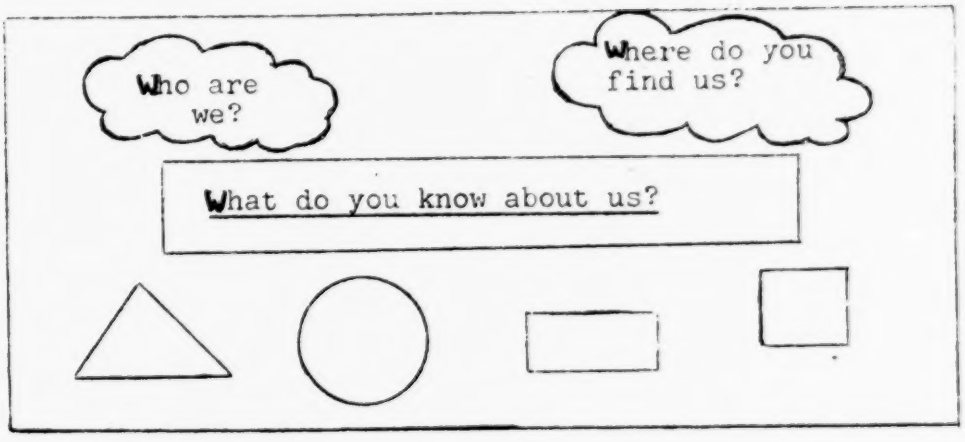
1. Creative English - make up riddles similar to the following:
   "I have six faces which are all the same shape. Which solid am I and what shape is each face?"
2. Cover the solid with construction paper; cut along the edges; flatten down to observe the net.
3. Art Activities; Make cartoons with the faces.
   Make designs with the cut out shapes.
4. Geo-boards: Make the faces on the geo-board and then make a drawing of the geo-board face.
5. Dramatization: Use long cords knotted at equal intervals and children to build the straight-edged faces. The children hold the cord at the vertices.



RELATED ACTIVITIES: (cont'd)

6. Booklets: Make a scrapbook of stories pictures cut-outs of the faces.

7. Bulletin Board Displays



8. Creative Writing: Let the children pretend to be one of the shapes and tell about himself.

9. Examine individual sets of geometric solids to find faces that are the same shape as those traced by the teacher.

10. Find within the classroom other solids with a similarly shaped face. (Pictures could be included).

11. Seatwork with many different shapes where pupil directions might be:
(i) Colour any shape with 3 corners red.
(ii) Colour any shape which has no straight sides green.

12. Who Am I Box
Make a box decorated with plane geometric shapes. Inside have many riddle cards about the faces. (Answers on back).

13. Touch and Tell About Me
A Geometric shape is drawn on large cards using some textured material e.g. glue, sand, strips of sand paper, wool.
The child is blindfolded and given the card. He traces over the shape with his finger, telling all he can about the shape,

RELATED ACTIVITIES (Cont'd)

13. (Cont'd)

naming it of possible

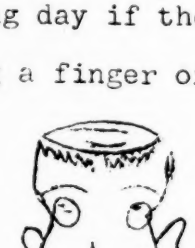
14. Games of Matching

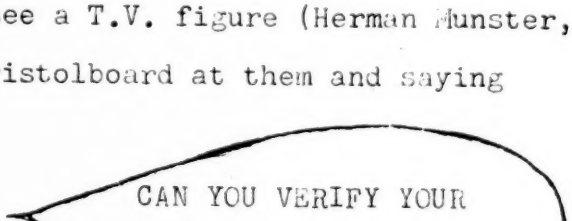
On a bulletin board there should be a set of geometric solid shapes and a set of faces traces from the solids.

Each face should have a long lace attached to it. The child matches the face with the solid it belongs.

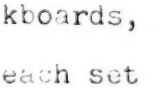
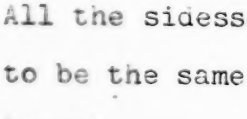
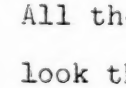
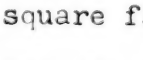
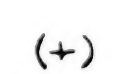
15. The set of faces and the set of solids could be displayed on the felt board. The child matches the name with the face.

16. Imagine how startled and enthusiastic your class will be the following day if they see a T.V. figure (Herman Munster, perhaps) pointing a finger of bristolboard at them and saying





Then starred discoveries, written on cards or on the blackboards, will be uncovered with a new manipulative material under each set of lettering.

SQUARE SHAPES	RECTANGULAR SHAPES	SQUARE SHAPES	
All the sidesseem to be the same length. 	All the angles look the same size. 	If you cut out 6 square faces, you could build a cube. 	(+) 
pages from a 'free' book of wallpaper samples	pieces of thick plastic.	pieces of foam rubber	

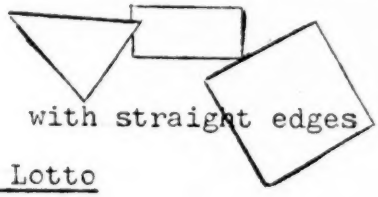
RELATED ACTIVITIES (Cont'd)

17. Sorting Cut Out Faces Into Sets

Children may use their cut out shapes or felt shapes.

e.g. 1. Set of shapes with no corners.

2. Set of shapes with three edges, etc.

3. 

Set of shapes with straight edges

18. Geometric Lotto

Make a set of cards, divided into squares. In each square place a plane shape and colour the square. Cover this card with acetate. Each card will be different. The teacher also has a set of cards, with one single coloured shape on each card.

The teacher holds up her card and the child looks for the identical colour and shape on his card, and marks it with an X. The child who fills his card with X's first wins.

Review and summary of the characteristics of the two-dimensional shapes.

N.B. If, at this point, the children seem anxious to 're-build' shapes from cut-out faces, they may start Topic 4-Unit Two and explore it before continuing Topic 2.

AIMS:

1. To review the names of the two dimensional shapes e.g. circle, triangle, square, rectangle.
2. To have the children collect and record, as a class, all the information about each of the two dimensional shapes, and thus review the characteristics of each of the shapes.

GENERAL approach;

There are many ways to review the characteristics of 2-D shapes. Some should be in the form of games, but at some point during the review, permanent charts should be built up as a reference source for pupils. We have listed different ways to approach the review, and suggest that you choose as many ways as you feel is necessary for your own class.

APPROACH A:

The teacher and class should set up the kind of record they wish. (paper makes a more permanent record)

The children should be allowed to give headings for the charts as well as the pertinent information. Interest will be heightened if the children build up individual charts on stencils as the large chart is built up on experience chart paper by the teacher.

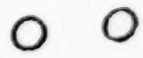
APPROACH A: (Cont'd)
e.e.

ALL ABOUT THE PLANE SHAPES

Name	Solid it is on	Number of Edges	Number of Vertices	More About Edges	More About Vertices or Corners
Circle					
Triangle					
Square					
Rectangle					

APPROACH B:
Let the children build smaller charts as you build a larger chart.

Faces of Solids

Solids	Shapes	Names of Shapes
Cylinder		2 circles
Square Pyramid		1 square 4 triangles
Triangular Prism		2 triangles 3 rectangles
Cone		1 circle
Rectangular Prism		2 squares 4 rectangles
Cube		6 squares

APPROACH C:

GRAPH GAMES

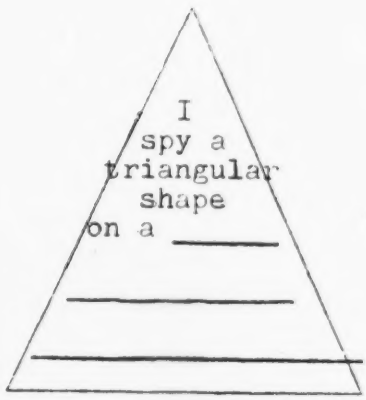
Have your children play a graph game, filling the squares with the correct shapes of faces cut from gummed paper.

	1	2	3	4	5	6
1. Rectangular Prism						
2. Cube						
3. Triangular Prism						
4. Cone						
5. Square Pyramid						
6. Cylinder						

APPROACH D:

I Spy Shapes

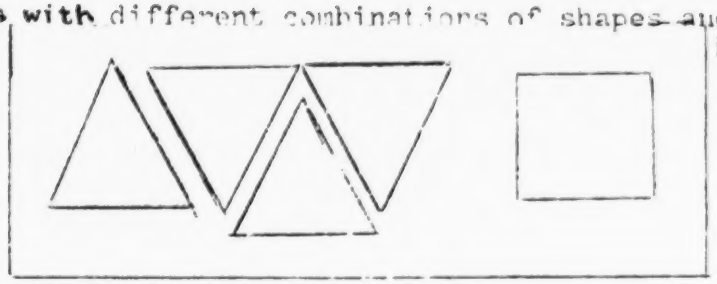
As stories are built on large shapes invite the class to build up similar stories on stencilled shapes.



I spy a square shape on a ___

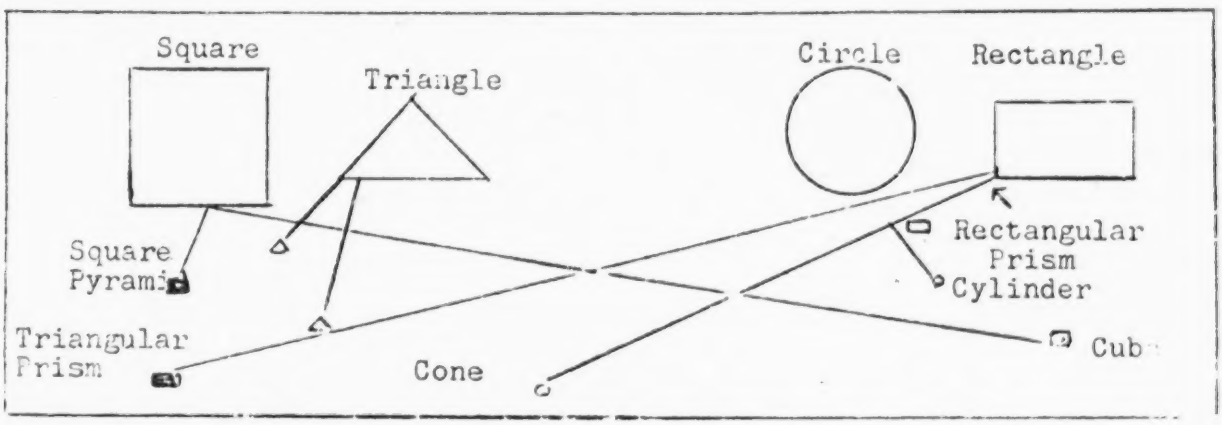
APPROACH E:

Show flash cards with different combinations of shapes and ask which solid have these shapes



APPROACH F:

Diagram Charts



APPROACH G:

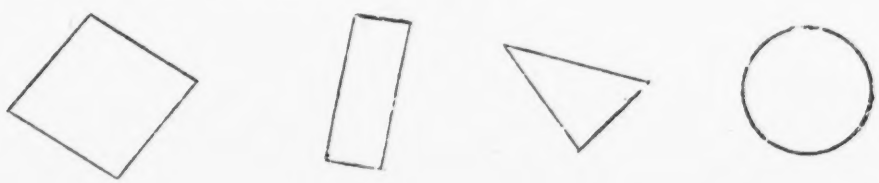
TAPE RECORDER RIDDLES

Tape riddles similar to these--'which solid has rectangular shapes, but no square shapes?' Let children hold up solids as answers, circle correct answers on stencils, or write answers.

APPROACH H:

Turn-Around-Time-

Hold face shapes in different positions and see if pupils can identify the shapes as squares, rectangles, etc.



APPROACH L:

Home Assignments

Encourage your class to collect pictures of real objects with face shapes similar to the shapes found on solids. Individual scrapbooks or large class booklets will grow quickly.

APPROACH J:

Supply the children with an assortment of mosaic tile shapes on desks and ask them to move shapes required onto velour paper.

i.e. Which shapes would I find on a cube?

APPROACH K:

Mobiles

Children may create mobiles with straws and pipe cleaners hanging from wires.

Triangular Prism Mobile

Cube Mobile

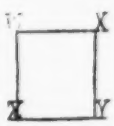
RELATED ACTIVITIES:

1. Children could make up their own recording charts.
2. Fitting faces to cut out faces.

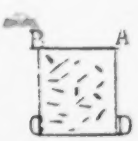
   This is to see how many different ways the cut out face will fit on the exact drawing of the face. Estimate first, then fit them together to see if the estimation is correct.

   e.g. square

   Right Side Up



   Upside Down

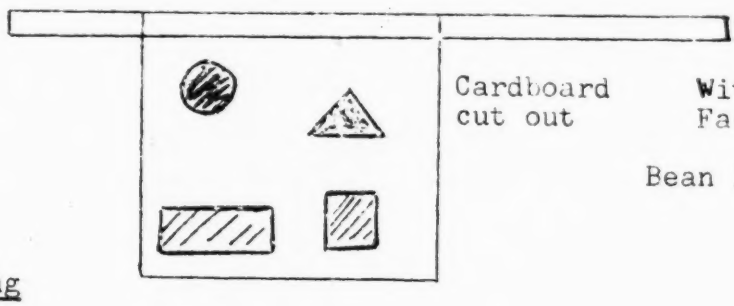


The children will find that ABCD fits on WXYZ four ways right side and four ways upside down.

RELATED ACTIVITIES. (Cont'd)

3. Bean Bag Toss

Each child takes his turn throwing his bean bag through one of the cut out faces in a large sheet of heavy cardboard. He then receives a point for each of the characteristics he can tell about the shape.



4. Drawing

Given straight edge, ruler, pencil, compasses, the children could have much fun drawing the shapes on plain paper. These drawings could be to reproduce a pattern set up by the teacher, or to create an original design.

5. Arrays

Given paper with arrays of dots on which are drawn certain shapes, by joining the dots, the children could be asked to draw a rectangle with sides , a shape twice as large, half as large, etc.

Teacher's Drawing

Draw a rectangle twice as large

6. Geo-Boards

Work Sheet (example)

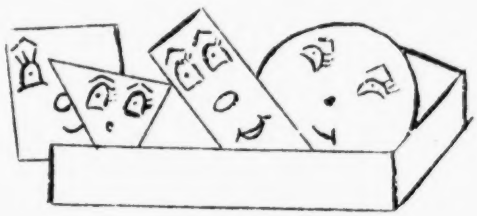
1. On your geo-board make a shape that has three equal sides and three vertices.

RELATED ACTIVITIES(Cont'd)

6. Geo-Boards (Cont'd)

   2. Now make a square using one side of the above shape as one side of the square. (Grade One and early Grade Two could be given the instructions orally).

7. Finding Faces

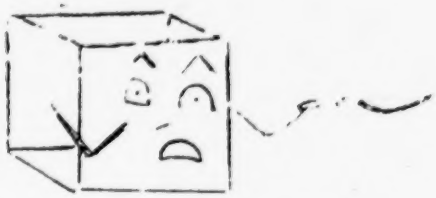


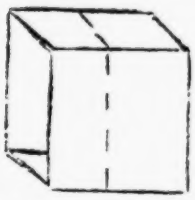
You will probably have children questioning you about the faces on a sphere. Create an aura of suspense. Ask them to wait for the 'sphere surprise'. Using the overhead projector, filmstrip projector or a strong flashlight, shine the light on different solids, leaving the sphere until last. Discuss the different shapes outlined by the light. When the sphere shape shows a circular face in the light, present a styrofoam sphere (pre-cut if desired) and ask what shape would appear if you were to cut the model through the centre. (Let the children cut their own small plasticine or styrofoam spheres with ordinary kitchen knives.) Cut in different places to discover different faces. (Always a circle).

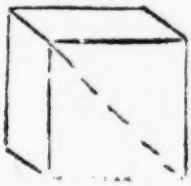
Start a class discovery chart and add to it each day.

RELATED ACTIVITIES· (CONT'D)

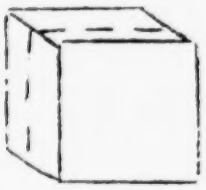
7. Finding Faces (Cont'd)







CUBE CUTS



Results
- 2 rectangular prisms
- new rectangular faces

-new triangular faces
- new rectangular faces
- 2 triangular prisms

-same as (1)

Children quickly learn to make solid shapes from plasticine. Let the class discover the new shapes (using plasticine and table knives) before you separate the styrofoam models.

TRIANGULAR PRISM CUTS

Results:
-2 triangular prisms
-new triangular faces

-new rectangular faces
-a smaller triangular prism
-trapezoidal prism
-trapezoidal faces
-new triangular faces.

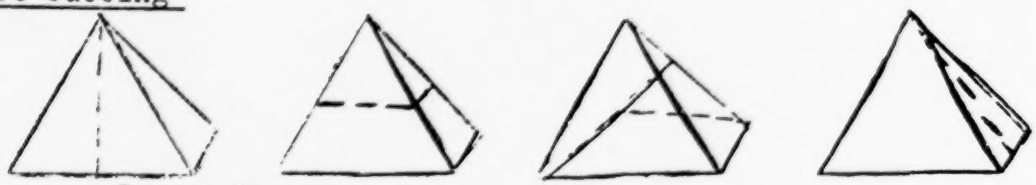
-2 right-angled triangular prisms
-new rectangular faces
-new triangular faces

Let children suggest different cuts, estimate orally what the new sections will be like, then cut their plasticine prisms to discover whether or not their calculations were correct.

RELATED ACTIVITIES (CONT'D)

7. Finding Faces (Cont'd)

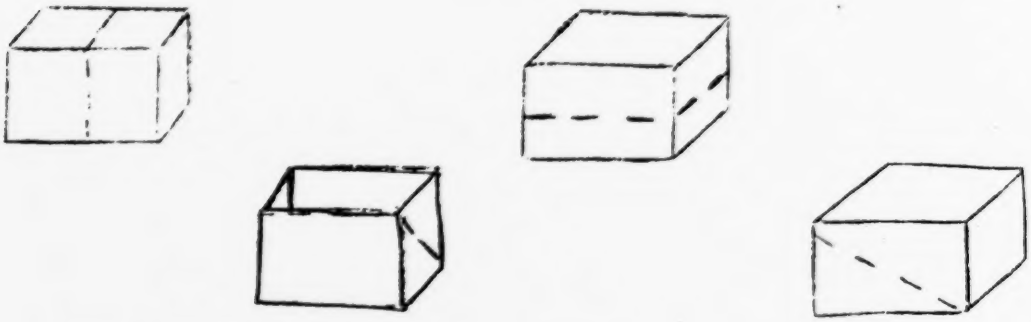
More Cutting



Square Pyramid

Cylinder

Cone



Rectangular Prism

EVALUATION:

The purposes of evaluation should be:

A to learn which concepts the children have not grasped.

B to evaluate each child without pressures of time, competition, or fear of failure.

C to provide a further learning situation.

Daily anecdotal records about the class and individuals could be kept. (The form these would take would be up to the individual teacher.) All work sheet tests should be made in keeping with the ability of the children. Grade One and possibly early Grade Two work sheets should involve more matching of pictures, colouring and cutting and pasting. In Grade Two and Three the work sheets would involve questions about the characteristics of the plane shapes, and their relation to the geometric solids, as well as opportunities for drawing the plane shapes. (if the children have had experience with this.) This evaluation should be part of the regular mathematics programme and should be treated as a normal related activity. Individual interviews are a most important method of evaluation for Grade One, and would serve a very useful purpose also for Grades Two and Three. Short oral concept tests should also be used. These could be placed on tape, along with answers, thus allowing individuals or groups to test and mark themselves.

N.B. A variety of methods of evaluation should be used. Children should have access to the three dimensional and two dimensional shapes during evaluation periods.

TYPES OF EVALUATION:

1. Cutting type

Make up sheets of stencilled shapes with directions on a separate sheet.

i.e.-

> Cut out the shapes of the faces you would find on a square pyramid. Paste them here. (Be sure you have the right number of faces as well as the correct shapes.)
>
>

2. Tracing Type

Trace and name the faces of a rectangular prism.

3. List Type

Make a list of the solids which have faces with triangular shapes.

_____

_____

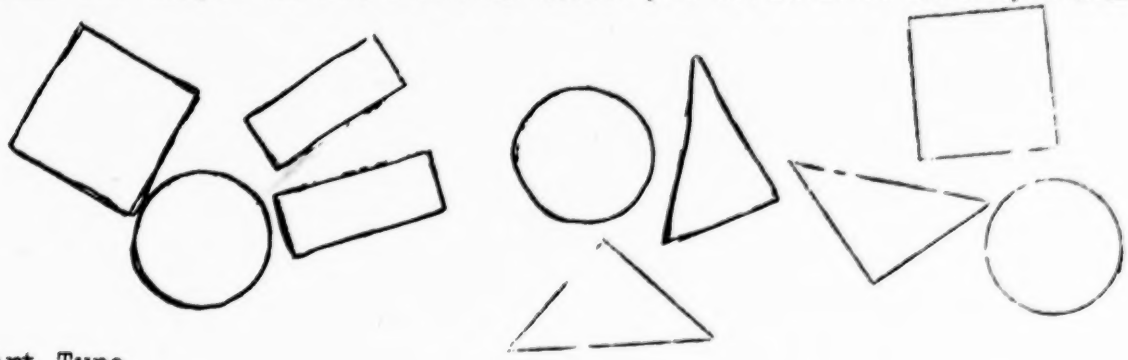
_____

_____

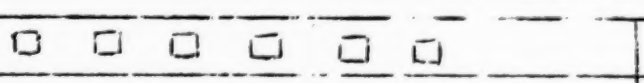
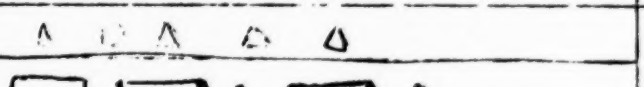
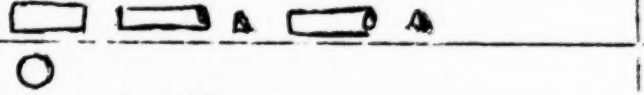
TYPES OF EVALUATION: (Cont'd)

4. Circling Type

Circle the shapes of all the flat faces you would find on a cylinder.



5. Chart Type

Name the solids with these faces.	
	cube
	
	

6. Tape Recorded Questions

Answers may be circled on a stencil or written.

7. Slide Test

Prepare coloured slides with pictures of shapes found on solids - children

8. Name the shapes shown on test sheet.

9. Draw a triangle, a square, etc.

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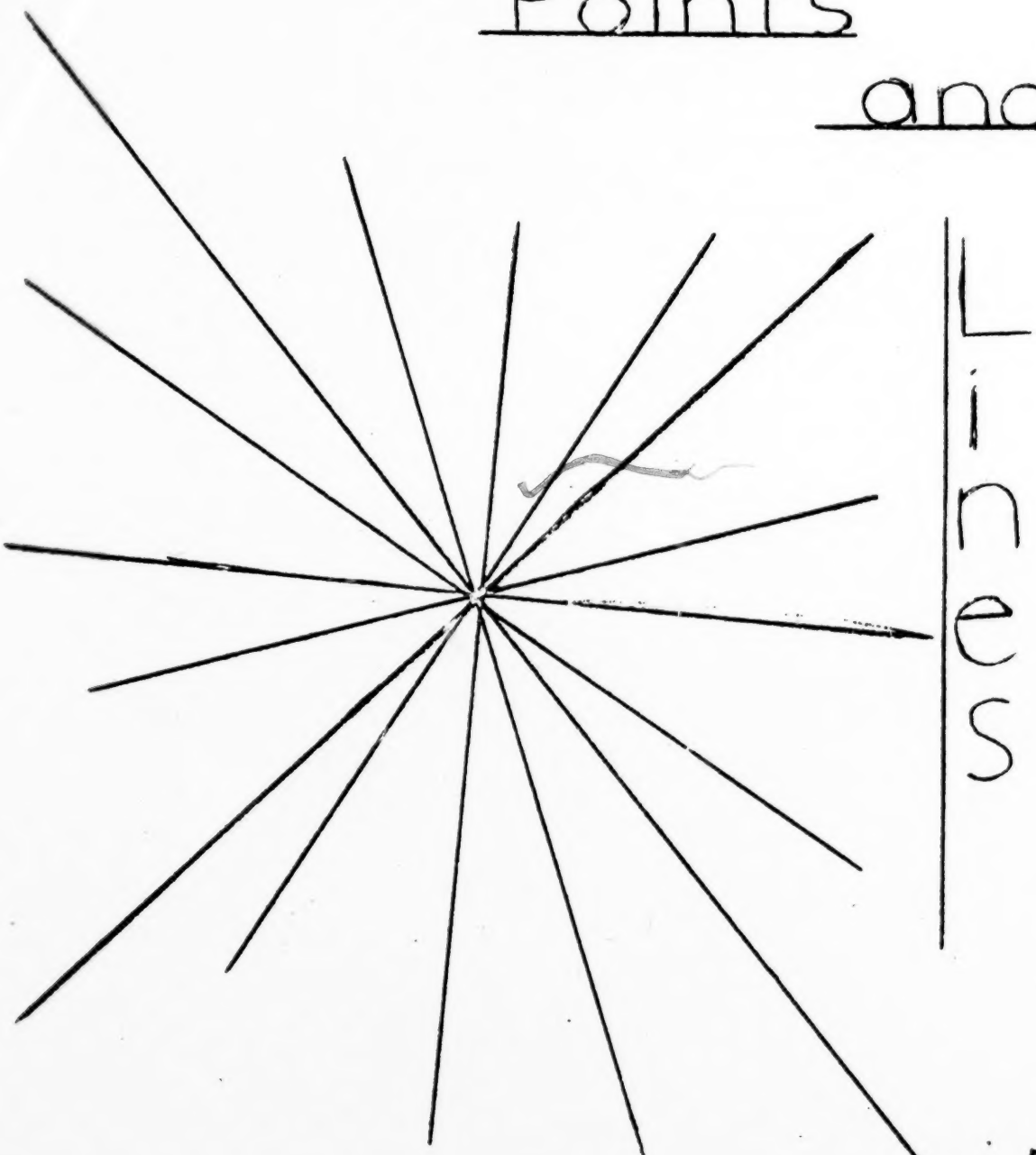
Topic Three

Points and Lines



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TOPIC THREE

POINTS AND LINES

GENERAL AIMS

To guide the pupils, through observation and examination:

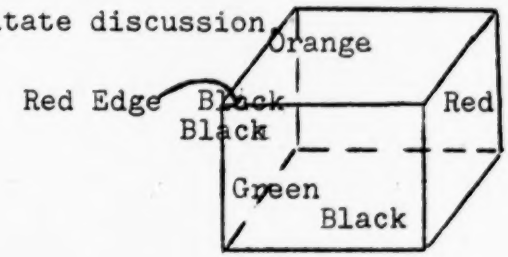
1. to understand the interrelation of point, line and plane.
2. to visualize more clearly the components of the geometric shapes as found in the environment.
3. to understand that two points fix a line
4. to understand that two lines define a point where they intersect
5. to know that lines may intersect, be parallel, be skew, (any two non-adjacent lines in space) depending on their position in space

AIMS:

1. to introduce the edges of solids as lines
2. to discover that some lines intersect, while others do not intersect, i.e. by examination of each of the solids, excluding sphere and cylinder, the children will learn that some faces meet; some faces do not meet; some edges meet; some edges do not meet and travel in the same direction (parallel); some edges do not meet and travel in different directions (skew)

APPROACH:

Mark the faces in some manner with animal or flower seals, letters, numbers, colours; and the edges with coloured chalk, or coloured tape. This will facilitate discussion.



Grade 1 and early Grade 2

This will be a class lesson with the children examining each of the solids in turn to find answers to each of the questions. Perhaps a small group of four or five will share each solid.

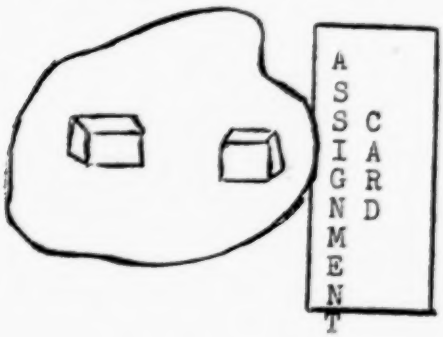
Examples of Questions to
Promote Discussion following the Examination
of each Solid

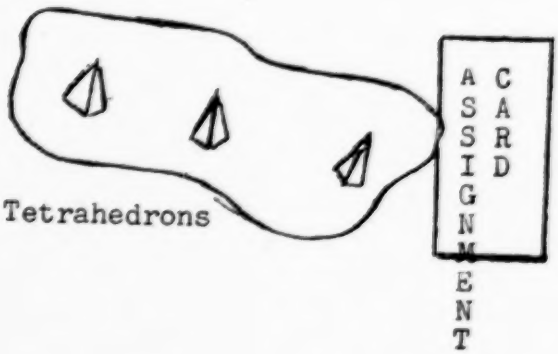
1. What am I?
2. What do we call the place where face A meets face B?
3. Which faces meet at the green edge or line?
4. How many edges or lines are there?

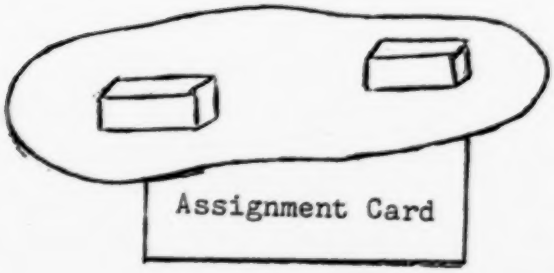
5. How many faces are there?
6. Run your finger along the red line. Where does the red line go?
7. Where does the red line meet the green line?
8. What do you call the places where the edges or lines meet?
9. Put a red dot on your solid where three lines meet; a blue dot where four lines meet.
10. Fasten a long pipe cleaner along the red line, and another one along the blue line. Do these lines go in the same direction? Will the lines ever meet? Why?
11. Fasten a long pipe cleaner along the yellow line, and one along the blue line. Do these lines go in the same direction? Will they ever meet? Why? What do we call lines that meet each other?
12. Find two other lines that do not meet but go in the same direction.
13. Find two other lines that do not meet but go in different directions.

Grades 2 and 3

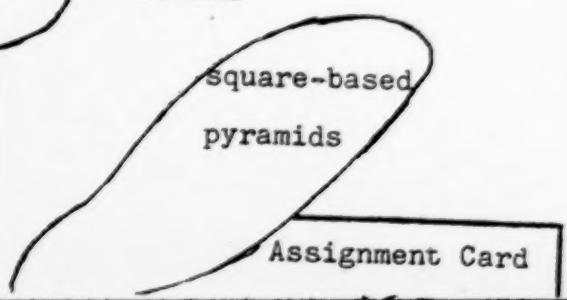
Geometric Solid Centres







Rectangular Prisms



Assignment Card Examples

I am a _____.

1. How many faces and edges do I have?
2. What do you call the place where the two edges meet?
3. Which faces meet face A?
4. What other name could we give the edges?
5. Which faces meet at the green line or edge? etc.

See the previous page for examples of more questions.

Have the children rotate through each centre, discovering the answers to the assignment cards, and recording their answers in some manner:

booklets (individual or group)

charts

Ditto Masters

blackboard lists

Following this work, each group should be responsible for reporting to the class about one centre.. Time should be allowed for discussion following each report.

AIMS:

1. to learn that the term line means a straight line
2. to recognize lines and curves in the environment

APPROACH:

DRAMATIZATION

A. Have pairs of children hold a stiff wire or taut string along, and extending beyond one edge of each of the solids. Then remove the solids. Discuss the appearance of the string or wire, re-enforcing the idea that it represents a line.

B. Now have children hold the ends of a skipping rope so that it is curved. Discuss the appearance of the rope and the kind of line it represents. Allow someone to draw a diagram of the rope on the blackboard or paper, and label it (curve).

C. Next, have the children hold the string of elastics in preparation for the game of "yogi". (If this game is unfamiliar to the children, have them hold a skipping rope so that it is taut.) Discuss the appearance of the elastics or rope, and the kind of line it represents. Draw a diagram of this line and label it (straight line).

Compare the two drawn lines, and discuss which one would be better referred to as a "line".

GROUP WORK

A. Set up centres with collections of geometric solids (closed cans, balls, boxes, plasticine balls, globes, regular geometric solids.) Have the children sort the solids into two sets: solids with curves, solids with lines.

Have two people from each group report about their sets. Allow time for discussion. (Curves could be drawn on the spheres.)

B. Now have the children discuss and record, in groups, all the lines they can find in the classroom, school, playground.

RECORDING AND REPORTING

Grade 1 and early grade 2 will find it easier to record their findings on tape. Then the tape should be heard and the findings discussed. Grades 2 and 3 could make written reports on foolscap, chart paper, etc. (These could be done individually or with one person acting as secretary for the group.) Then these records would be kept in booklet form for perusal and discussion by the other groups.

RELATED ACTIVITIES:

1. Globe

The globe should be set up on a table, with an assignment card and any other necessary equipment.

Assignment Card

1. Using plastitac and string, join Canada and South Africa, London (England) and Toronto. What kind of lines do these strings represent?
2. Can you find a perpendicular line on the globe? What do you think about this?
3. Find some other curves on the globe. What are they?

2. Games

Make a list of all the curved paths you need for games. Draw diagrams or pictures if you like.

Curves for Games

1. Doggie, Doggie, Who Has the Bone?
2. Ring a Round a Rosie
3. The Farmer in the Dell
4. Dodge Ball
5. Fox and the Deer - Tag Game
6. Tiddily Winks
7. Steeple Chase
8. Snakes and Ladders
9. Slot Cars

3. Make a booklet of all the curved paths found in and outside the building, e.g.: paths of planets
paths of space ships
trails of vapour left by jets
highways
rims of cups, saucers, wastebaskets

UNIT THREE

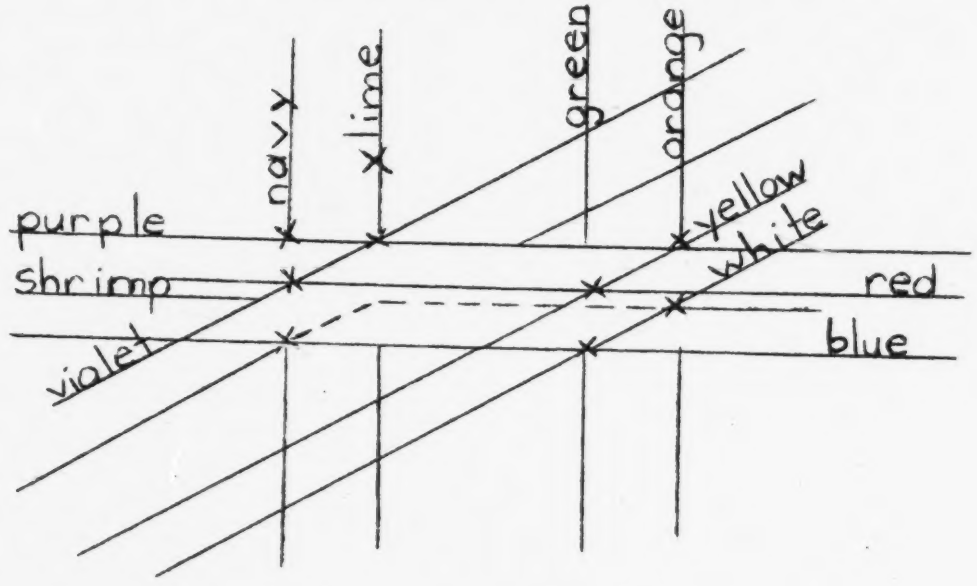
AIMS:

1. to classify lines into intersecting lines, parallel lines, or skew lines
2. to learn that lines may go on indefinitely in both directions
3. to learn that line segments go from one point of intersection to another

APPROACH:

Class Lesson

With the children's help, lay long pipe cleaners along the edges of a rectangular cardboard box. (e.g. Kleenex). Each pipe cleaner should be a different colour, if possible, for ease in discussion. Fasten them securely with thin wire, at the points where they intersect. Remove box.



Questions for Discussion

1. Which parts of these pipe cleaners represent the edges of the box?

(The children should indicate the line segments between the points of intersection.)

2. Now that the box is gone, we can't really use the term "edges". What could we call these pipe cleaners?

3. Look at the red line. Where does that go? If we had a pipe cleaner that never stopped, where would the line go?

4. Which lines meet? Where do they meet? (Use the term "intersect" when the children can cope with it.)

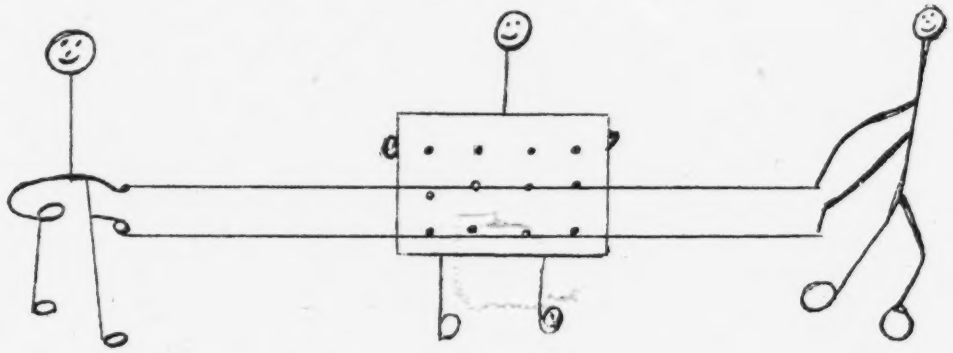
5. Which lines do not meet? Why do they not meet? (Introduce the term "skew" also "parallel" if the children are ready for them.)

Now have the children examine other geometric solids to find intersecting lines, parallel lines, and skew lines.

Use a geo-board and two strings to make lines (see diag.)

Discuss the fact that the lines are parallel and the reasons for this.

Let the children make parallel lines on their own geo-boards.



Have the children find some examples of intersecting, parallel and skew lines within the classroom.

(For Grade 1 and early Grade 2 it may be sufficient to find only intersecting and non-intersecting lines.)

Now arrange the children in groups to find all the skew, parallel and intersecting lines in the room, school and playground.

Recording and Reporting:

Grade 1 and early Grade 2 will just discuss and report their ideas orally.

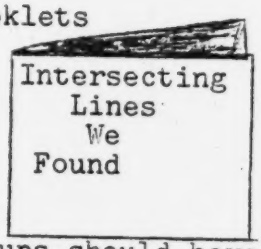
Grade 2 and Grade 3 may record their findings in these ways:

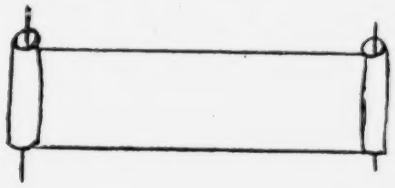
1. Chart form

Intersecting	Non-Intersecting

3. Blackboard list
4. Tape recording
5. Scrolls

2. Booklets





The groups should have an opportunity to examine and discuss the other groups' work.

AIMS:

6. to learn that (a) the position where lines intersect is a point
(b) the shortest distance between two points is a line

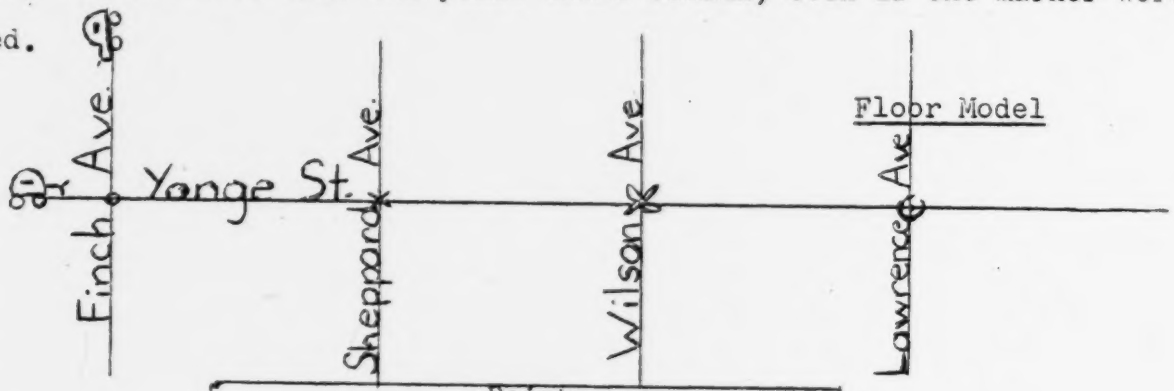
APPROACH:

Classwork

Using the skeleton model from unit three, have the children find the intersecting place of the red and green lines. Then proceed to mark all the other points of intersection with small balls of plasticine or plastitac. Discuss the fact that these positions are called "points".

Dramatize cars or people meeting at the intersection of two streets. Discuss the naming of this point.

Build a floor model of intersecting streets, using tape or lines on heavy cardboard. Have the children manipulate two cars so that they meet or cross paths at the intersection of two streets. Mark the spot of intersection with a coloured dot or bead. Discuss this intersection being a point, and the fact that the point would remain, even if the marker were removed.



Points
• YONGE, FINCH
* YONGE, SHEPPARD
YONGE, WILSON
YONGE, LAWRENCE

Using the model of the streets, discuss which path would be shorter between two points, a curve or a line.

Time a child walking between two points in the classroom, using both a straight path and a curved path. Discuss which path took less time.

Locate different positions of children or objects in the classroom in terms of intersection of lines. (These lines will, in a sense, be invisible.) Record these points on a chart.

POINTS
BILLY * THIRD BOARD, SUSAN
PIANO - SECOND LIGHT, DOOR

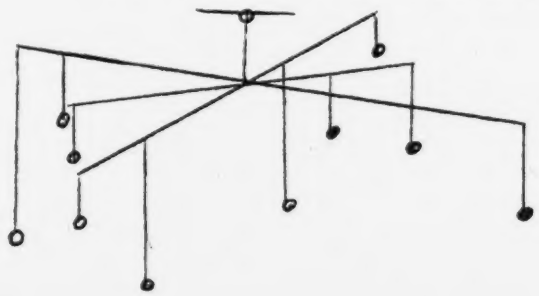
Now have the children make intersecting lines on their geo-boards. (Make certain the elastics are touching the board, so they will intersect.) Following this, allow the children to illustrate their intersecting lines on paper, using pencil and straight edge.

Group Work

Have the children work in groups to list all the points of intersection that can be found in the classroom, school and playground, e.g. corners of doors, corners of ceilings, and walls. (See previous unit for explanation of recording and reporting.)

Related Activities

1. Using a mobile constructed of fine thread and small coloured beads, have the children show the point which is highest, lowest, nearest, farthest, etc.

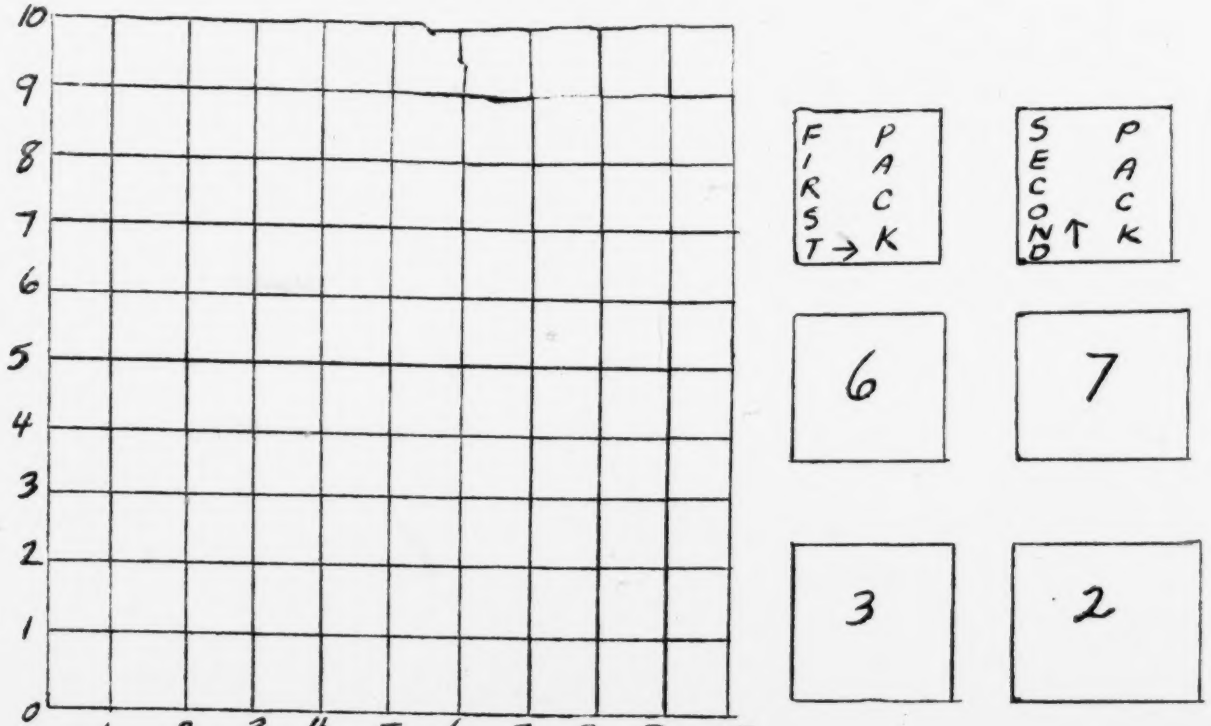


2. Take a trip to the baseball diamond and have the children stand on the points of intersection - home plate, first base, second base, third base. Then represent the points of intersection with the bases (sacks). Remove the sacks and discuss whether the point has been removed. Discuss the length of the lines. Return to the class and draw a diagram of the diamond using pencil, and straight edges. Label each of the points.

3. House-Line Game

Draw two intersecting numberlines and all the intersecting lines in that plane. (Cover the cardboard with acetate for marking and preservation.) The object is to be the first to position your houses, filling all the points in a line. (diagonally, vertically or horizontally.)

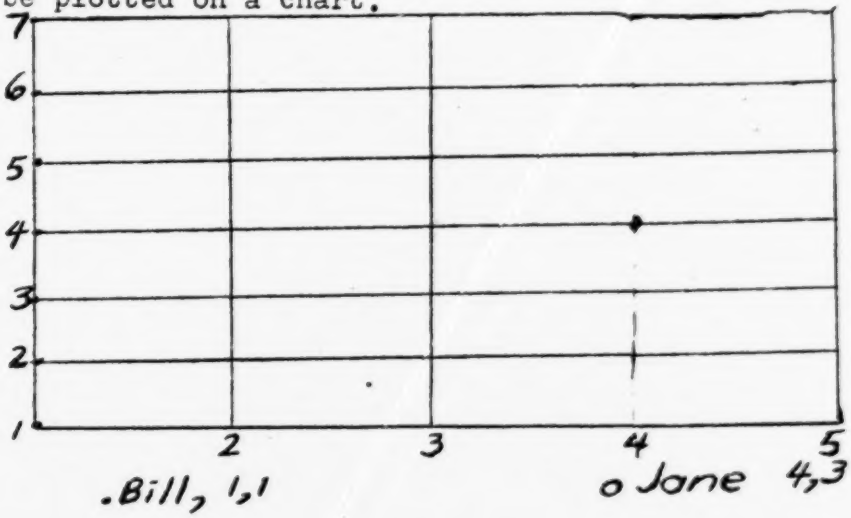
An agreement must be reached that the first number means the number on the horizontal numberline, and the second number, the number on the vertical numberline. Each player takes his turn drawing a number from two different packs of number cards. Then he places his house on that point of intersection.



Susan -6,7 Bill 2,2

4. Booklets containing lists of points of intersection.

5. If the children are seated in rows, their position in the classroom can be plotted on a chart.



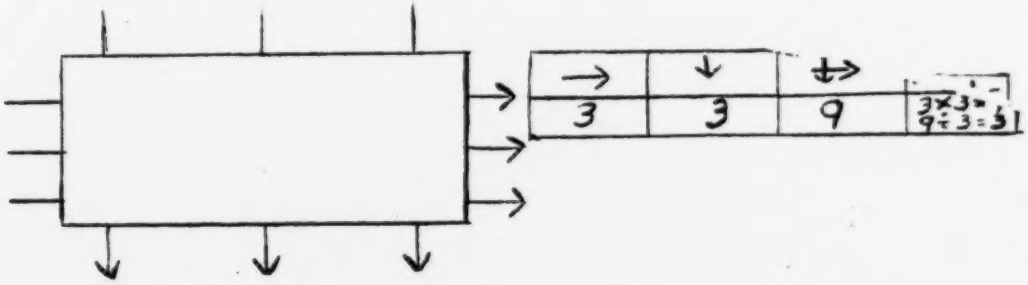
6. Game of 'here am I?

   e.g. I am in line with the first window, the door knob, and the letter r on the blackboard.

   The person who knows the position, goes and stands there.

7. Art: Make designs, using narrow strips of black and gray paper on a white background. (These colours are only suggestions, because of their effectiveness.)

8. Correlate with arrays in discovering multiplication and division facts in grade 3.



AIMS:

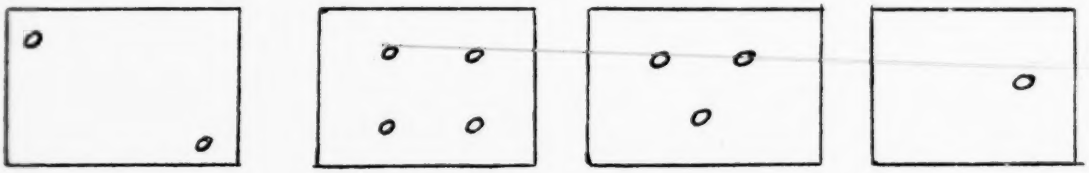
1. to discover how many lines may be drawn through a series of points
2. to discover the many shapes that may be obtained by drawing lines through a series of points
3. to discover the skeletons of faces that can be made by joining together line segments

APPROACH:

Grade 1 and early grade 2 will be a class lesson.

Grades 2 and 3 may be a group lesson.

A. Provide each child with dittoed pages of points, pencils and straight edge.



Let the children pretend that their pencils are walking along the edge of their straight edge, and that they must pass through each point. Now they must find out how many straight paths or lines they can draw through one-----six points.

They will also find out what kind of geometric shapes they can see in their drawings. Perhaps the different shapes could be outlined in different colours.

Grades 1 and 2: Each page should be done and discussed in turn.

Grades 2 and 3: Each group should discuss their findings and then choose a reporter to report to the class.

Now the children should place their own points on a page and join them by lines to see if their discoveries remain true.

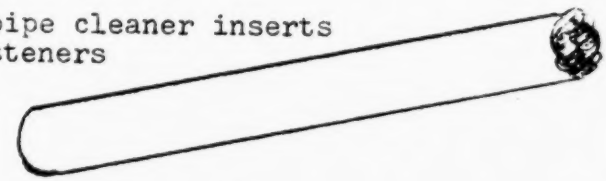
Have the children copy two or three of their drawn shapes on their geo-boards.

To find out at how many points two lines will intersect, let children at seats, blackboard and easels draw pairs of intersecting lines.

B. Now each group or each child should be provided with assorted lengths of material for lines, and fastening material. The problem is to see what skeletons of geometric shapes (faces) they can build.

Examples

straws with pipe cleaner inserts and paper fasteners



narrow strips of bristol board and paper fasteners, wooden sticks and glue; popsickle sticks and glue; pipe cleaners

When build is completed, each group or child should display its best results

HOW?

1. displays on a table
2. displays on a bulletin board
3. displays on sheets of bristol board

After the children have had an opportunity to examine the results of the other groups discussion should follow;

Examples of Questions to Provoke Discussion

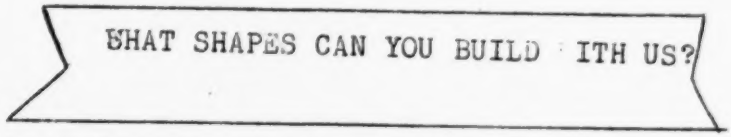
1. What difficulties did you have with the lengths you choose?
2. What did you notice about the lengths you needed to make a square shape, triangular shape, or rectangular shape?
3. Perhaps some of us made other shapes besides the regular ones. What can you tell us about these?

   (If the children ask for the names of the new polygons, they should be given. Refer to the dictionary of polygons at end of booklet.)

Children who wish to make skeletons of the three dimensional shapes should not be discouraged.

RELATED ACTIVITIES:

1. Set aside a table or corner of the room with building materials such as boxes of meccano, coloured sticks, straws, toothpicks, pipe cleaners, popsicle sticks, etc., for building more shapes.



2. Booklets of the shapes made by joining points.
3. Make mobiles from the skeletons of the shapes.

ED 070645

TOPIC FOUR

SYNTHESIS

AIMS

1. To review the characteristics of solids from an entirely different angle than any used previously.
2. To use various media to construct the skeletons of the different solids in order to reinforce and review the characteristics of the solids studied.
3. To become familiar with other skeletons and to discover the relationship of lines of various lengths in three dimensiohs.
   To relate these skeletons forms to the environment. (Eg. the framework of a house.)
5. To provide experimental experience for children in the building of solids from faces and skeletons. 6. To discover the relationship of faces of different size and shapes by arranging them in various patterns.
7. To provide an opportunity for children to discover new shapes, such as the tetrahedron.
8. To discover the relationship of different solids by arranging them to form new solid shapes.

SE 015 356

UNIT ONE

Building Skeletons of Solid Shapes

AIMS

1. To construct skeletons of solids given (a) straw of equal length
   (b) straws of two different lengths
   (c) straws of any desired length
2. To categorize the resulting skeletons and name any new ones.
3. To review the characteristics of solids through examination of skeletons.
4. To use constructions to build models of useful objects in our environment.
5. To discover what makes a skeleton rigid and to relate this discovery to everyday building and construction.

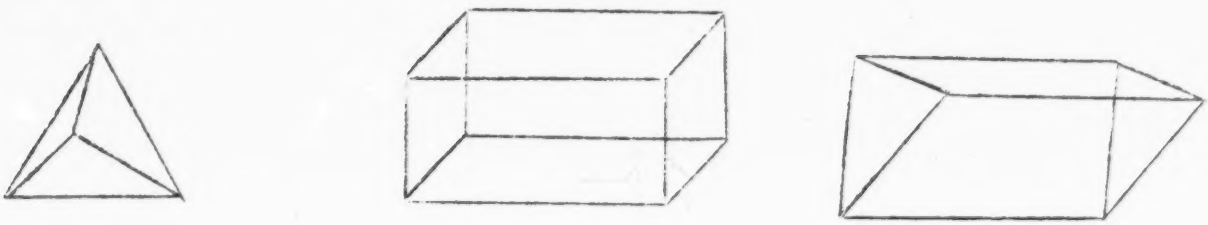
APPROACH

Primary children in particular are immediately excited when anything connected with 'Hallowe'en' is mentioned. If you have an old skeleton left from a Hallowe'en Cardboard Display, it could be used as an introduction to the 'Skeleton' unit. Tell the children a story about a wicked magician casting a spell on the solids and causing them to melt away into mere skeleton form. Ask the children to visualize what the solids would look like with nothing but bones left (edges, of course.)

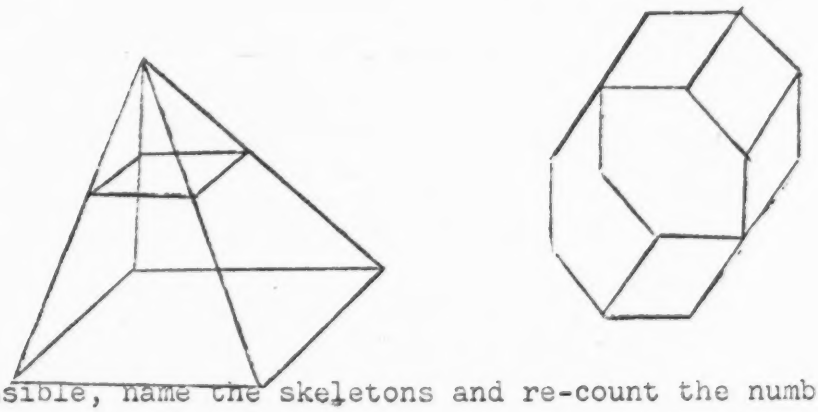
Present the pupils with a quantity of straws of equal length with enough pipe cleaners to join them.

Permit the class to experiment and discover what skeletons can be built with this material. Challenge them to build a skeleton that does not lie flat.

Some possible skeletons should include:



as well as more complex arrangements.



If possible, name the skeletons and re-count the number of straws used, the number of corners, the shapes outlined by each set of straws.

Under particular circumstances the teacher may wish to omit this experimental stage and proceed by restricting the number of straws and by offering particular guidance. To do this most economically the class may be divided into four centres. Ask the pupils to use only the material suggested at each work centre. If a child finishes one skeleton let him proceed to the second one, and so on.

First Centre: A large sign with a dangling skeleton saying: All the straws are the same length. Use only six lengths to build your skeleton. Be sure that you build a skeleton that does not lie flat.

Second Centre: A similar sign with nine lengths.

Third Centre: A sign referring to twelve lengths.

Fourth Centre: A sign referring to eight lengths.

Other Centres may be set up using different lengths. The first four centres may produce tetrahedrons, cubes, square pyramids and triangular prisms, as well as very complex shapes heretofore undiscovered. These nonconformists who produce unusual shapes and designs should be encouraged. They may be the mainsprings of creative talent for the future generations.

When many shapes using equal straw lengths have been produced, ask the children to examine and categorize the shapes. When unusual shapes come under observation, let the children suggest names for the shapes, and tell where they have seen similar shapes in everyday life.

Through comparison with the actual solids, ask the children to find the skeletons that resemble a cube (for instance.) If someone mentions that the cube will not stay erect, but is flexible and falls to one side, the question of rigidity will enter the picture. If it does, ask the children to try to discover a way to make the skeleton rigid. As soon as diagonals are added, the 'construction' section of unit one has begun. Ask how this skeleton could be used as a model for something in the environment and the construction of skeletons for houses, bridges, etc. may begin immediately.

The second stage of construction of skeletons could include:

(a) straws of two lengths

(b) straws of 4 lengths

(c) problems where number of straws of each length is specified
Eg. (What can you build with 4 short straws and 4 longer straws)

(d) straws cut by the pupils to the desired length.

Since variety is the spice of every lesson, do not limit the children unless absolutely necessary to only straws and pipe cleaners. There are many materials available which will add spark and interest to experimentation:

(a) knitting needles and rubber tubing

(b) wire and plasticine

(c) popsicle sticks and plasti-tak

(d) plastic tubing

(e) balsa wood strips and airplane glue

(f) toothpicks of wood and/or plastic

RELATED ACTIVITIES

1. Writing a story about one of the skeletons and an adventure it had on Hallowe'en night.
2. Finding practical use for the skeletons-i.e., a toast holder, serviette holder, spoon supporter for the table, decoration for a flower pot, a support for climbing ivy, etc.
3. Construction of a city with buildings made from rigid skeletons shapes, bridges, motor vehicles, etc, all in skeleton form-SKELETON CITY
4. Group construction of a chart on a particular skeleton to show its characteristics. (lines, corners, faces, rigidity)

5. Designing a 'skeleton' for art-either in the abstract or objective and adding to a display case. Dressing this skeleton by cutting out faces or clothes. The display could include unusual names for the shapes as well.

UNIT TWO T-4 Page 7

AIMS

Building Solid Shapes From Faces

1. To approach informally and formally the constructions of solids from faces.
2. To discover new shapes made fron different combinations of faces.
3. To discover the relationships between faces of different shapes.
4. To categorize and name the shapes resulting from construction of solids using faces.
5. To use the constructions in model-building.

APPROACH

As with the skeleton construction, there are many different methods of constructing solids with faces and many different media available. The following is merely a suggestion to be used as an aid-in whole or in part. The room may be set up with seven to ten work centres and a different approach may be used at each work centre. Here are some suggestions:

Work Centre One Prepare a work chart, a solids-shapes lab and a camera. The instructions on the work sheet could be merely a challenge such as: Use some of the shapes in the shapes lab to build a solid. List the shapes you used and the number of each shape you needed. Put the list beside the shapes and take a picture of the shapes. Now replace the flashbuld and move on to a new centre.

Work Centre Two Display plastic equilaterial triangle set out in different colours

The challenge could be-How many triangles do you need to build a solid?

Work Centre Three Have cardboard squares of different colours set out with scotch tape and a large cube on display. Challenge: Try to build this shape using the paper shapes on the table.

Work Centre Four Use one of the shapes on the centre table to trace a net of the solid. Now fold the paper and scotch-tape the net together to form the solid.

Work Centre Five A solid shapes lab with directed assignment cards. Instructions would be similar to the following: Use a pentagon and five triangles to build a solid. What is a good name for the new shape?

Work Centre Six Trace all the faces of the triangular prism (for instance) on the sheet of foam rubber. Cut out the faces. Build a triangular prism from foam rubber.

Work Centre Seven A work sheet is provided showing two circles and a rectangle. The instructions are: Cut out the faces and try to build a solid shape. You may bend the shapes if you wish, but you may not cut or fold them. What shape did you build?

Work Centre Eight Use the clear plastic shapes to build a rectangular prism, plus other work cards with similar instructions re the use of the clear plastic shapes.

Related Activities

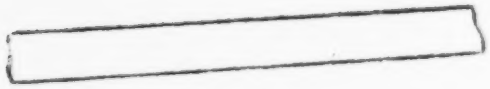
1. Display Case 'I Spy'- One child describes the faces of one of the shapes on display and the other children try to guess which shape he is describing.

2. Logic Game - One pupil conceals a shape from the rest of the class. He answers yes or no to other children's questions. The questions will refer only to the characteristics of the shape. By the process of elimination the pupils are able to name the correct shape.

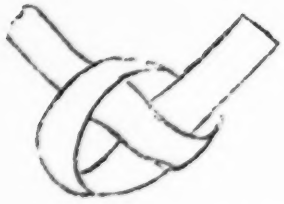
3. Area - using squared paper, find the approximate area of each shape.

4. Net Display - of nets of all solids

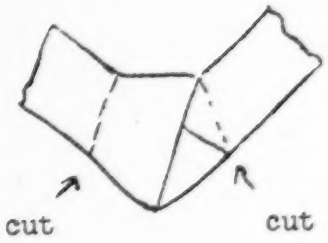
5. Pentagon Folding Knot



Step 1- Cut a $\frac{1}{2}$ inch strip of paper.

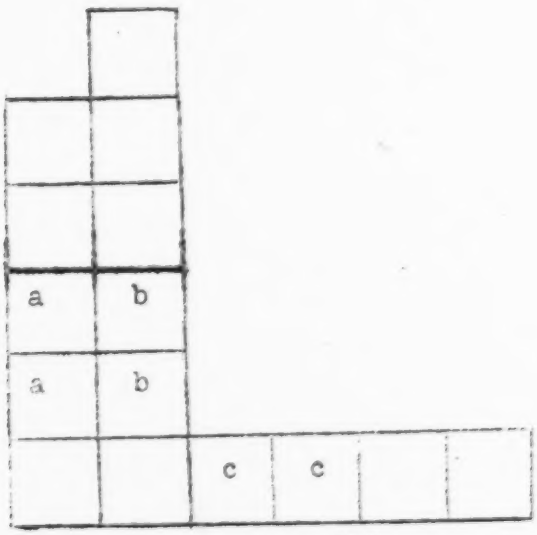


Step 2-Tie a single knot.

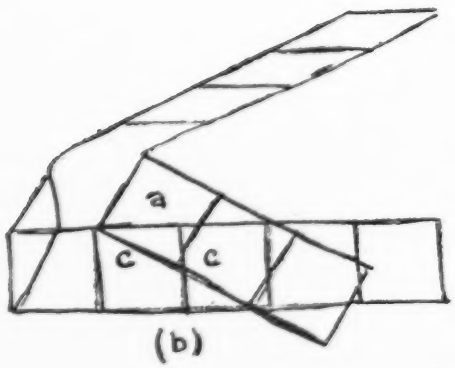


Step 3- Pull tight and cut off the strip.

6. The Braided Cube



(a)



(b)

First plait a over b completed
Second plait c over a
Third plait b over c